THE

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ELECTRICAL REVIEW.

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A STEP TOWARDS EFFICIENCY.

UNDER the title of "Organised Scientific Research," *The Times Engineering Supplement* prints in its issue of Wednesday, 7th inst., a strong plea for the formation of a Research Co-ordination Committee, which, it may be hoped, will receive very careful consideration by the councils of our engineering and scientific institutions. It is urged—and we think justly urged—that such a central body might do for experimental work what the British Engineering Standards Committee has done, and is doing, to further the efficiency of our factories.

In all schools of thought and spheres of activity, even in those devoted to politicians, we are now confronted by a demand for efficiency. Every-day engineering routine has impressed upon central station and factory alike the imperative necessity for the most efficient use of fuel, machinery and labour. Improvement along these lines is obviously one of those matters which should begin at home, very much as Carlyle's dictum on honesty was addressed first to the individual. Unless the unit be sound, the mass cannot be homogeneous. Thus it is that the organised battalion—which is in itself only a unit in a division or an army corps—is composed of soldiers each of whom has undergone his recruit stage of instruction. In certain classes of warfare, indeed, organisation is superfluous. But in the stress of the commercial competition taking place within our borders organisation is now a paramount factor. Still more important, and to an increasing degree each year, is the need for organisation of a national character. To-day profits in any manufacturing process rest upon efficiency of production. To-morrow our national position in the world's markets may depend far more on national organisation than on questions which are purely a matter of political economy.

Electrical science shares with metallurgy and chemistry a dependence upon research work for its progress towards a higher development, and a knowledge of its inter-relation with other branches of science is a specially important factor. Its inter-dependence upon metallurgical research has been well exemplified both by the recent improvements in transformer and armature iron and by the production of metals of high melting point for metallic-filament lamps.

But, even with the knowledge and appliances now at our command, there is the danger that, in investigating the vast realms of unexplored research, our methods may be of a wasteful nature. One nation, at any rate, we know to possess a racial sense of discipline combined with a genius for organised co-operation, and it is this latter quality that we need to cultivate.

The article to which we refer puts forward six propositions, as axiomatic, of which we quote the first, third and fifth :—

"1. It is not scientifically efficient for the same subject to be investigated in the same manner and the same futile conclusions obtained, because those who have failed have refrained from leaving any record of their work, which would have tended to prevent redundancy.

"3. The publication of records of inconclusive work will promote scientific efficiency by indicating what lines of attempted progress have been unsuccessful.

"5. The value of co-ordinated research is of national rather than of sectional interest. A recognition of this view has, in the past, brought about the constitution of various committees to deal with such subjects as gas engines, the thermal efficiency of steam engines, alloys, cement, rail corrugation and corrosion."

The article then proceeds to discuss the *personnel* of a suggested committee to organise the whole field of scientific research "appointed very much in the same way as the members of the Engineering Standards Committee are appointed," with, of course, an adequate number of sectionalised sub-committees. A scheme of procedure is outlined, which provides for the calling, by any sub-committee, of a conference at any suitable locality on the subjects embraced within its sphere. Such a conference would be a preliminary to the organisation of any research by the sub-committee. It would be obligatory, however, for the sub-committee to summon to the conference all members of the various institutions supporting the research co-ordination committee who were concerned with the subjects in question. "Later abstracts of reports and summarised conclusions would be . . . . embodied in the proceedings of the institutions covered, credit of name and priority of discovery being given to the contributory investigators . . . . it would, however, be a moral obligation upon all to communicate details of what they had found to be futile, *always provided that the financial interests of others were not prejudiced thereby.*"

The italics are our own. This is one of the rocks upon which the scheme might founder. If researches are carried out in our factories in collaboration, say, with the college or private laboratories, the interests of shareholders require to be safeguarded. This should not prove an insuperable difficulty. The article closes with a plea for the calling of a conference in order to discuss the feasibility of the project, and if necessary to get out a scheme of organisation, and to devise ways and means for the establishment and maintenance of such a committee. We trust that the conference may be arranged. The proposal has in it the germ of important possibilities. A conference would indicate how far these possibilities are divisible into the respective categories of unattainable ideals, and achievable ends calculated to promote our national efficiency.

Hiring and Wiring.

As mentioned briefly in our last week's issue, a somewhat abortive meeting of the "Electrical Committee" was held last week "to discuss the advisability of undertakers under the Electric Lighting Acts being empowered to wire premises and supply apparatus for the consumption of electrical energy or otherwise."

The Committee is formidable enough on paper to justify a little disappointment at the very meagre attendance, even though due allowance is made for the rival attractions of electioneering and the fact, which must have been well known to the Committee, that the conference between the contractors and municipal supply interests was still endeavouring to arrive at a satisfactory solution of the difficulties which have arisen in connection with the same matter.

As it was, the "dhictathor" in the shape of Mr. G. Harland Bowden, President of the Electrical Contractors' Association, imposed silence on his followers, in view of the situation, and the discussion consequently became somewhat informal in character.

The company supply interests, as represented by Messrs. Garcke, Campbell-Swinton and Gripper, favoured the granting of the additional powers to the Corporations, possibly sharing Mr. Campbell-Swinton's opinion that unless such powers were granted, the Corporations, when exercising their powers to purchase company supply undertakings, would refuse to take over the wiring and hiring businesses carried on in connection with them.

Mr. Vignoles, the Grimsby engineer, confined himself to demonstrating the necessity of allowing the Corporations to hire-out, if not sell, apparatus, with a view to educating consumers; Mr. Gripper, who confessed to dual interests, as both contractor and electricity supplier, strongly supported this view, pointing out that it paid a supply undertaking to give a seven or even 10 years hire-purchase, a lengthy period which neither the manufacturer nor the contractor would give. Mr. J. S. Raworth complained that municipal wiring jobs were not only unprofitable to the Corporations concerned, who would only make 3 per cent. on them at the most, but the contractors were deprived of work on which (according to Mr. Raworth) a contractor would manage to extract some 15 to 20 per cent. profit. He considered that this capital might be more profitably employed elsewhere, and as regarded motor hiring—well, a sort of universal motor hiring syndicate could be floated to supply all present and future needs in this direction.

The mouth of the contractor having, as previously mentioned, been officially closed, Mr. Harland Bowden's assurance that all was well with the Conference was all that could be expected from that quarter. He did indeed assure us that the contractor would make a better canvasser than those at present employed, and Mr. Rawlings further added that he might be better received because of his "disinterestedness" as regards the supply—all of which we have heard before, together with much of the other side of the question, tending to make us believe that just on account of this disinterestedness in the supply and sufficiency of other interests which do not benefit the supply engineer, the contractor cannot be expected to make a satisfactory canvasser from the former's point of view.

We fully agree with Mr. Rawlings as to the necessity of better business organisation on the part of London's electricity suppliers as a whole, but it seems obvious that Mr. Raworth's 15 or 20 per cent. contracting profits would scarcely run to the expense of the systematic canvass of all possible consumers—some of little or no value to the contractor—which is of first importance to the supply engineer.

It seems just possible that the great underlying question of what is the best for the industry, is rather obscured by the many party interests in evidence, and it may therefore not be out of place to express a hope that the spirit of conciliation which is in evidence just now, will not lead to any restriction of the by no means too rigorous search after fresh business and of the various inducements which are being held out to possible consumers by supply authorities.

Any slackening in this direction—any hampering of the powers of competition with rival illuminants—can only prove, in the end, injurious to the industry and to all concerned in it.

Queries on Heat.

A correspondent, who some time ago led a very animated discussion in our "Correspondence" columns on the absorption of light, now returns to the charge with some questions relating to heat radiation, which, though apparently elementary, are really worthy of attention.

There is no doubt that questions involving heat energy are often dealt with in an extremely loose and inaccurate manner. There is, perhaps, no terminological solecism more commonly met with than the use of the word heat to denote temperature; but this is mainly due, no doubt, to a deficiency in our language as popularly spoken and understood. We often speak of "heat" when we mean "hotness," and in any discussion on the subject care should be taken first of all to ensure that the scientific, and not the colloquial, meaning of the terms employed is to be adhered to.

As regards Mr. Bastian's queries, the first is easily disposed of. The external dimensions, nature and surroundings of the radiating surfaces being identical, and care being taken that the conditions under which heat is transmitted from the heaters to the interior walls of the cubes are also identical, then if both cubes are supplied with energy at precisely the same rate, they will both attain the same final temperature when the rate of dissipation of energy by radiation, conduction and convection is equal to the rate at which energy is supplied. For the rate of radiation of heat depends only on the nature and temperature of the radiating body, *caeteris paribus*.

The second question, however, does not lend itself to a satisfactory solution, for the reason that time must be taken into consideration. Although every body possesses an appreciable capacity for heat, it does not necessarily follow that heat need be supplied to it at a greater rate, in order to raise it to a given temperature, than to maintain it at that temperature; indeed, provided that the rates ultimately become equal at the moment when the desired temperature is reached, the rate at which heat is supplied need only be slightly in excess of the rate of dissipation at any instant in order to produce a steady rise in temperature.

But whether the rate of supply of energy will be greater in the former case than in the latter depends wholly upon the time taken to raise the temperature between given limits; the capacity for heat of the body is, it is true, an important factor, for if the capacity is very great in comparison with its radiating surface, and the final temperature is small, the rate at which heat must be supplied to the body to bring it to the desired temperature in a given time may be much greater than is necessary to maintain that temperature when attained—but even in this case time is the essential element in the problem.

Questions such as these are of very material importance to electrical engineers; they enter prominently into the design of generators, motors, and transformers—of rheostats, of radiators, of cooking apparatus, and of lamps—to say nothing of the problems that are met with in connection with the prime-movers used in electrical engineering. Fortunately, as evidenced by recent papers on some of these subjects, such questions are now receiving the careful consideration that is their due, and we do not doubt that those who approach them on scientific lines will reap the benefit of their investigations.

The L.C.C. and its Fuel Supplies.

The Minutes for this week's meeting of the London County Council contained an important report of the Stores and Contracts Committee, dated October 18th, upon the arrangements for the supply of coal to the Stores department of the Council, the annual consumption of which amounts to 115,000 tons, while the Greenwich generating station consumes a further 140,000 tons per annum. This report the Council has adopted.

The Committee have decided, after a full examination of all the information available, that the system of purchase now in force is capable of improvement, more especially in relation to the "general supplies" portion of the Council's fuel consumption, amounting to 50,000 tons per annum, and they recommend two important alterations in the existing system of purchase. The first of these, is, that the coal should be purchased direct from the collieries, and not as hitherto through the agency of contractors or middlemen; and their second proposal is that an expert coal officer should be appointed to give his whole time to the preparation of the details of the scheme to be adopted, and later to the carrying out of the plan ultimately decided upon by the Council. The Committee support the first of these proposals by the statement that under the present system of purchase it is difficult, if not impossible, for the Council to assure itself that the contractors are supplying coal from the pits specified in the contracts. The experience of the Metropolitan Asylums Board, and H.M. Office of Works, is cited in proof of the advantage of dealing direct with collieries rather than through the agency of contractors and middlemen.

As regards the appointment of an expert coal officer, the Finance Committee of the Council have already agreed to the proposal, and have submitted in their estimates a special maintenance estimate of £100 in respect to this new office for the current financial year, and one of £400 for the expenditure to be incurred in 1911-12, and in each ensuing year.

We think the London County Council, in endorsing, as they did at Tuesday's meeting, the latter of these two proposals, have taken a wise step in relation to their fuel supplies. Coal is one of the few raw materials which is still too often bought and sold on absurd and unscientific regulations as to quality, and any system which proposes to upset our antiquated rule-of-thumb methods of purchase is worthy of support. But, is a salary of £400 a year sufficient in London to obtain an expert with the right qualifications, or to place him above any pecuniary blandishments offered by colliery companies in spite of Sir Edward Fry's Bill? And is the Committee's assumption that coal from a specified pit or seam is always of definite quality and value, quite in harmony with the facts? We fear that on both these points the Council will find they have been misled by the report of their own Committee, and that not only a larger salary for their expert, but regular and systematic sampling and testing of their deliveries will be necessary in order to secure that fair relationship between price and quality which they desire.

If a majority of the members of the Committee who drew up the Report which we are discussing had had more practical experience of the coal-mining industry, they would not have been so trustful as to assert that purchase of coal direct from the collieries is "a simple and effective safeguard against the supply of coal other than that contracted for." Clearly the members of the Stores and Contracts Committee of the London County Council, in spite of all that has been published on this subject of "Fuel purchase," have still much to learn.

We venture to express the hope, therefore, that the Expert they appoint will make up for their deficiencies in this respect, and will give evidence of some acquaintance with the progress that has been made in America, Germany, and in this country, in applying more scientific safeguards than that offered by colliery guarantees to the quality of fuel supplies.

For if the word of a middleman or contractor as to the origin of the fuel supplied is not to be trusted, why should that of a colliery official be considered any more worthy of belief? Every colliery produces fuel of various qualities and values, and on this account alone, systematic sampling and testing is the only real check upon the quality of the fuel. A further argument for the adoption of more scientific and exact methods, is the fact that, among other evil results of the Eight Hours Act in the coal-mining industry, an increase of ash in the slack and small coal from many districts is to be noted. This increase is believed to be chiefly due to the lack of care exercised by the workers in the mining and loading of the coal, and it is most marked in the South Wales mining district—from whence London derives much of its fuel.

D

RECENT DEVELOPMENTS IN INDUCTION MOTOR DESIGN.

When induction motors were first introduced some 20 years ago, one of the chief advantages claimed was their extreme simplicity, consequent on the absence of commutators and

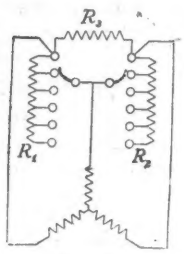

Fig. 1.

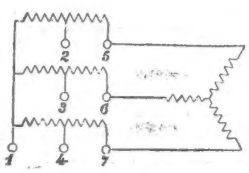

Fig. 2.

brushes. In time, however, it came to be understood that this simplicity brought certain disadvantages with it, *e.g.*, a comparatively low starting torque and a heavy starting current. When, therefore, Leblanc and Dobrowolsky showed that, by the introduction of resistance into the armature circuit, the starting current could be reduced, and, at the same time, the starting torque increased, it was hailed as a great advance, and the addition of collector rings and brushes was considered to be fully justified.

Experience with such motors soon showed that an unexpectedly heavy consumption of brush material occurred—a fact which has also been noted in connection with alternators in which the alternating current is collected by means of rings and brushes. This difficulty was partly got over by reducing the working currents used in the rotors and by employing carbon brushes, although the increased contact resistance thus introduced lowered the efficiency of the machine by as much as 1 per cent. or 2 per cent. In order to avoid this loss, some makers introduced devices for internally short-circuiting the slip-rings and lifting the brushes after the machine had reached full speed. The starting of such a machine thus involved four independent operations: (1) Closing the primary switch; (2) gradually short-circuiting the starting resistance; (3) short-circuiting the rings; (4) lifting the brushes. These operations had to be carried out in the order given, and in order to reduce the risk of error, the four operations were sometimes reduced to two by combining the main switch with the resistance switch and also the internal short-circuiting device with the brush-lifting device.

With a view to further simplification, numerous attempts have been made to arrange the starting resistance inside the motor itself, so that the cutting-out of resistance, the short-circuiting of the winding, and the lifting of the brushes might be carried out in the proper order by a single operation.

The motor can then be safely left in the hands of quite unskilled persons, and is, therefore, improved from the point of view of the user, but, on the other hand, it is distinctly more complicated in design and less easily supervised, cleaned and repaired. Herr J. Fischer-Hinnen in an article in the *E.T.Z.* for July 14th, 1910, describes some of the latest forms of this type of motor, and he considers that an extended demand for such machines is likely to occur in the future.

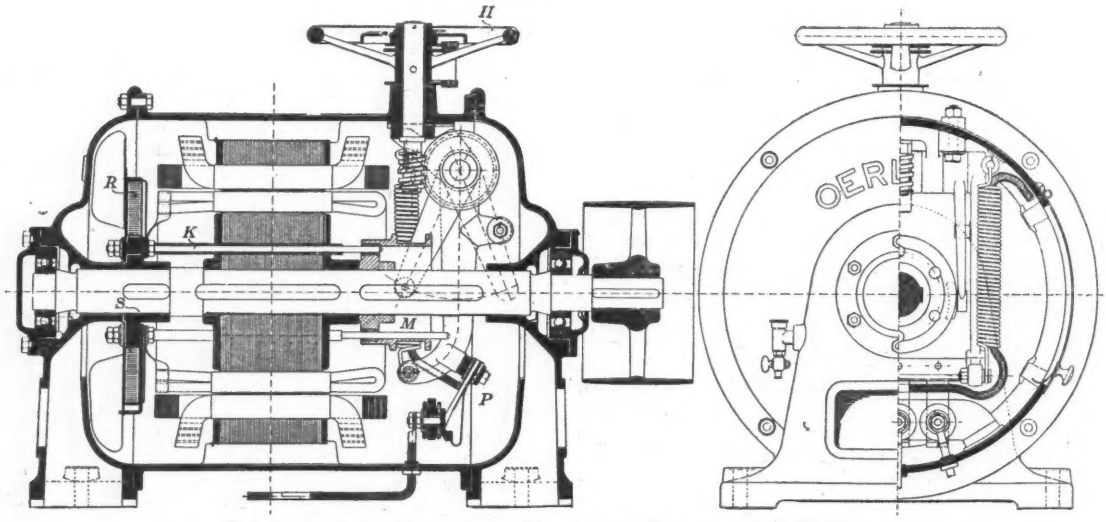

Fig. 3.—Oerlikon Three-phase Motor with Self-contained Starter.

Experiments in the construction of motors with self-contained resistances have shown that the chief difficulties occur in connection with the contacts, especially when the number of these is large, owing to the effects of centrifugal force. Consequently, only a single resistance step per phase has generally been employed, and although this is fairly satisfactory with motors starting light, it does not prevent

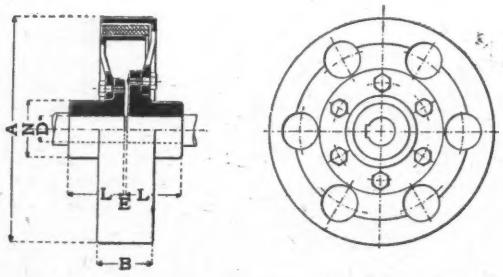

Fig. 4.

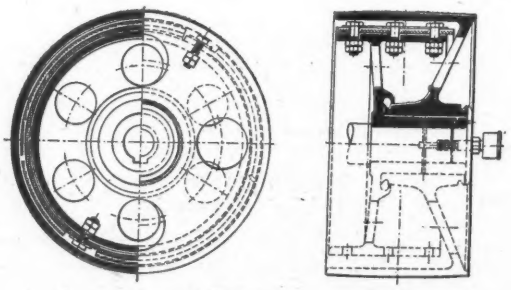

Fig. 5.

heavy current rushes with motors intended to start under even moderate loads. Thus, with normal proportions and correctly-designed resistance, a 10-H.P. three-phase motor, if provided with a single resistance per phase, will take a maximum current about 3·13 times the normal current, and will develop a maximum torque about 2·3 times the normal torque; if the resistance has three steps, these figures are 1·95 and 1·8, whilst if there are seven steps (which is seldom exceeded), the values are 1·39 and 1·4.

With a view to obtaining the benefits of a large number of contacts as economically as possible, the resistances are sometimes mesh connected, as shown in fig. 1, and regulation is only carried out in two of the three phases; in this way only two-thirds as many contacts as usual are necessary. Another arrangement, due to Kahlenberg, is shown in fig. 2. Here, instead of resistance being cut out of all phases simultaneously, steps are cut out of the different phases

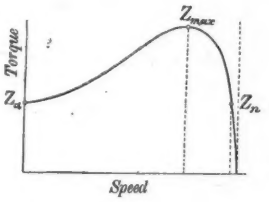

FIG. 6.

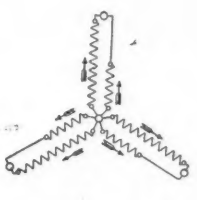

FIG. 7.

successively. When starting up, the points 2, 3, 4, &c., are connected consecutively with the neutral point 1. Such a starter with only two resistances per phase acts approximately like an ordinary resistance with five steps per phase. With three steps per phase this type becomes equivalent to an eight-step normal starter. Both these arrangements are especially suitable for motors with self-contained revolving resistances.

The arrangement adopted by the Oerlikon Co. is shown in fig. 3. The resistance R is composed of strip wound on a spider S, which also serves as contact carrier. The contacts consist of split rods K of great and unequal length arranged around the spindle, which are short-circuited in turn by the movable collar M. The length of the contact rods gives them a certain flexibility, and allows the centrifugal force to ensure a good contact. For smaller motors up to 25 H.P. six contacts are sufficient, but for larger sizes nine contacts are used. Starting is accomplished by turning the hand-wheel H, which not only short circuits the resistance by means of the fork and collar M, but also operates the main primary switch P during the first half-turn. The dimensions of the starting resistance are astonishingly small, owing to the fact that it is arranged to act as a fan and has a constant stream of cool air over it. The casing of the motor is arranged for rotation into any position, so that the hand-wheel can be brought to the top or bottom or side of the machine as desired.

Many attempts have been made to retain the simplicity of the squirrel-cage rotor whilst reducing the starting current and increasing the starting torque. The simplest way of getting over the trouble is to arrange the motor for starting light by means of fast and loose pulleys or other mechanical devices, but these arrangements are generally quite as expensive as the provision of collector rings and brushes on the motor. Simple centrifugal couplings, such as are shown in figs. 4 and 5, are better. These consist of two concentric cylinders, the outer one of which may conveniently form the driving pulley of the motor. They are normally separated, but are mechanically connected as the speed increases by the centrifugal force acting on a leather strap carried by the inner cylinder. With such an arrangement starting up at reduced current is effected either by a star-mesh connection of the stator windings, or by the use of an auto-transformer for reducing the stator volts at starting.

There is still considerable confusion as to the conditions under which a squirrel-cage motor starts up. It is often supposed, for instance, that the load on the motor at starting influences the amount of the starting current. In reality both the current and the torque of a given motor depend only on the speed, as shown by the well-known torque curve (fig. 6). It is only the time taken by the motor to reach full speed which depends on the load. If z_n represents the torque corresponding to the load on the motor pulley, and if this is equal to or less than the starting torque z_a of the motor, the machine will start up with increasing acceleration until the value z_n on the falling part of the curve is reached. If z_n exceeds z_a the motor will not start at all. From this it will be clear that the object of loose pulleys, centrifugal couplings, &c., is not to increase the torque of the motor or to reduce the starting current, but simply to delay the loading of the motor until the speed corresponding to the maximum torque z_{max} has been reached. Since a comparatively small torque is sufficient to start an unloaded motor, whilst the maximum torque of a motor is usually several times as great as the normal torque, it thus becomes permissible (with unloaded motors) to reduce the starting torque below the normal starting torque, by, for instance, temporarily coupling the stator windings in star for starting purposes, whilst the normal running connection is in mesh. In this way the starting current is reduced to one-third of its old value, whilst at the same time the pulley is enabled to start with something like twice as much load on it as before.

In addition to the mechanical arrangements for starting squirrel-cage motors, there are a number of purely electrical devices having the same object. One of the oldest is the use of two independent rotor windings, one with high resistance, for use in starting, and the other, of low resistance, for normal use after the motor has nearly reached full speed. Görges's arrangement, shown diagrammatically in fig. 7, is an improvement on this. Here two windings of unequal numbers of turns are connected in opposition for starting, and are then both independently short-circuited for normal working. All these arrangements, however, suffer from the fault of having too few steps, so that large current rushes at one stage or another are difficult to avoid.

Boucherot employs a double motor consisting of a single squirrel-cage rotor common to both stators, but having an extra high resistance short-circuiting ring connecting the centre points of all the bars, in addition to the two ordinary low-resistance rings at the ends. One of the stators is arranged to be movable through a small angle by a worm wheel. At starting the stators are so set that the voltages in the two halves of each rotor bar oppose one another, so that the only path available for the rotor currents is through

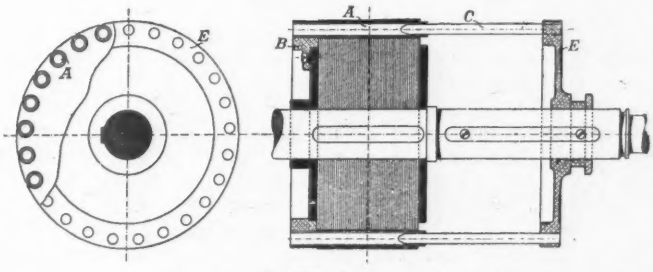

FIG. 8.

the high-resistance control ring. As the motor runs up in speed the stator is gradually moved round until the two stators induce similarly directed voltages in the two halves of the rotor bars, and thus enable the rotor currents to circulate in the ordinary way through the low-resistance end rings, leaving the control ring currentless. The only objection to this arrangement is the comparatively high price of the machine.

In some cases the Oerlikon Co. have constructed motors with the short-circuiting rings of iron. This has the effect of (1) increasing the rotor leakage at starting, and so reducing the starting current, and (2) increasing the eddy currents induced in the rings by the leakage flux, these eddy currents increasing the useful torque appreciably. The power factor of the motor is, however, slightly lowered at the same time. This lowering of the working power factor can

be avoided if, instead of iron rings, a separate notched iron block is arranged to slide up against the core end during the starting period, and is then drawn away again out of range of the magnetic leakage during normal working. The use of iron resistances built in the rotor has also been tried, but without very satisfactory results up to the present.

Finally, Herr Fischer-Hinnen describes an interesting arrangement recently patented by the Oerlikon Co. It consists of a squirrel-cage rotor in which the bars consist of thin metal tubes of high resistance (A, fig. 8). Into these tubes a set of horizontal rods C are arranged to slide by means of the collar E and a suitable fork. At starting the rods are withdrawn, as shown, so that the rotor has a high resistance, and as the speed increases, the rods are gradually pushed home until they completely fill the tubes up and give the rotor a very low resistance for normal working. The change is effected quite gradually and without causing any sudden jumps of current. The rods are split and are arranged flexibly, so that the centrifugal force ensures a good contact between the tubes and the rods.

Some tests carried out on two 12-H.P. three-phase motors, one of which had an ordinary squirrel-cage rotor and the other this new type of rotor, whilst both had exactly the same stators, showed the following results :—

	Squirrel-cage rotor.	Rotor like fig. 8.
Normal current	34 amperes	35 amperes.
Starting current	190 amperes	48 to 40 amperes.
Starting torque corresponding to	13 H.P.	12·4 H.P.

In this case the new type of rotor was constructed with steel tubing, as this could be most easily obtained, and the results would have been even better if tubing of special high-resistance alloy had been employed.

ELECTRIC STEERING GEAR FOR SHIPS.

By K. TROWBRIDGE.

On modern ships of even moderate tonnage, hand-operation of the steering gear in all but cases of emergency is unthinkable ; on small ships the wheel in the deck navigation house may directly control a steam engine over the tiller head, through chains and rods, but in larger vessels the latter become so cumbrous that a second steam or hydraulic engine becomes necessary near the wheel house to control the valves of the main engine aft.

In the majority of cases this second auxiliary engine and its heavy transmitting linkwork would unhesitatingly be replaced by an electrical system of controlling the main steering engine while, carrying the substitution one stage further, the rudder itself could be directly operated by an electric motor. Both methods of working are in use, though few English vessels of any importance employ other than steam or hydraulic steering gear. At the present day electrical steering appears to be mainly confined to American and Russian vessels (a peculiar collocation).

The first essentials of any steering gear are that it shall be reliable, simple and prompt in response to all movements of the wheel ; in these respects electrical apparatus finds it difficult (though not impossible) to compete with steam and hydraulic gear. The chief disadvantages of the latter are cumbrousness and inefficiency, and in both these respects electrical control offers considerable improvement. In the past the complexity of many suggested electrical schemes has proved their downfall. On shipboard, and particularly in such a vital duty as that of steering, relays and similar delicate devices are totally unsuitable ; what is required is a simple scheme of control, involving no conditions which cannot be indefinitely maintained under the most unfavourable conditions, and requiring none but the most robust switchgear, motors and gearing. Cheapness and lightness are merits only secondary in importance to reliability and prompt and accurate response to the helmsman's wheel. It is now usual to reproduce the motions of the wheel or rudder, and to indicate the ship's course on the bridge and in the captain's cabin ; electrical operation of the steering gear naturally facilitates this repetition.

The control of a main steam steering engine by an electric motor operating its valve gear involves no principles or problems not occurring in a purely electrically steered vessel. Hence, and because of space limitations, we will pass directly to the consideration of the latter type. It may at once be

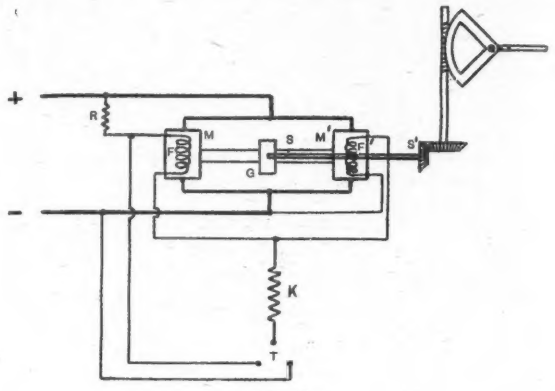

Fig. 1.

stated that the mechanical details of electrical steering gear do not differ appreciably from steam-steering gears. In almost every case the worm—bevel—or spur—geared wheel coupled to the electric motor shaft is mounted where the corresponding gearing from a steam or hydraulic engine would otherwise be placed. Apart from the possible provision of an extra speed-reduction, owing to the higher speed of electric motors, no difference need be made in the steering gear itself.

Union Electricitäts Gesellschaft System.—The wiring diagram for this system is as shown in fig. 1. Two similar motors are run in parallel and mounted on one bedplate, differential gearing, G, between their shafts causing an inner shaft (running through the hollow shaft of one machine) to run in one direction or the other according to which motor runs the faster. The inner shaft controls the rudder as shown, and normally M and M′ run at equal speeds, S S′ being

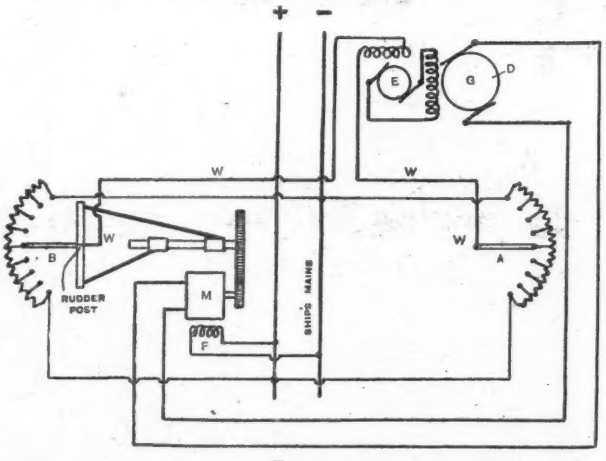

Fig. 2.

then stationary and the rudder trailing. The simple two-way switch T in the wheel house (operated by the wheel) enables a resistance K to be placed in parallel with one or other of the field coils F F′, thus causing M or M′ to run faster respectively, and, through S S′, to turn the rudder in the desired direction. The power required to move the rudder is supplied nearly equally by M and M′ ; the equipment is eminently simple and reliable, its only defect—but that a serious one—being the difficulty of persuading M and M′ to run normally at identically equal speeds, no other synchronising devices than constructive similarity and adjustment of the machines during testing being possible as the machines stand. It should, however, be quite possible to obtain a synchronising arrangement which would still permit of the wheel-house gear unbalancing the motor speeds as required.

Pfatischer System.—In this system the motor M—driving the rudder through spur gearing and a right and left threaded shaft with nuts, link coupled to the tiller head (see also fig. 3)—is supplied by a generator D. The latter driven by a steam or Diesel engine is excited by the machine E on its own shaft. Now the excitation of E, and therefore the generator output and the supply to M, depend on the current flowing in the wire W W—which is nil when A, B are on corresponding studs of their rheostats, but in one direction or other, from the ship's mains, at all other times. A is coupled to the wheel in the deck house while B is mounted on the tiller head ; on moving A to the right or left, as may be required, E and D are excited in one direction or the other, and M moves the rudder to right or left till B reaches the position corresponding to that of A ; the tiller is held thus till the wheel is again moved.

By a variation of this method the motor may be fed from the ship's mains, a set of relays (operated by the back E.M.F. of the armature, increasing with speed) cutting resistance in or out of the armature circuit as required to control the machine.

Of all the means of securing synchronism between the wheel-house and tiller-head gear, that employing a "Wheatstone bridge" circuit (see fig. 2), with the master control device in the balance (or "galvanometer") wire, is at once the simplest and most reliable.

Brown-Haigh System.—The essential features of this system are a continuously running steering motor, electro-magnetic clutches and numerous mechanical improvements in the gearing which, admirable though they are, have no bearing on the electrical features of the apparatus. The system is at present undergoing tests at Edinburgh, so far with excellent results.

The cost of *continuously* running the steering motor is not disproportionately great, for the steering gear is in almost incessant use even on long, straight runs in smooth water. The smooth demand from the ship's mains, resulting from the continuous running of the motor and its friction clutch

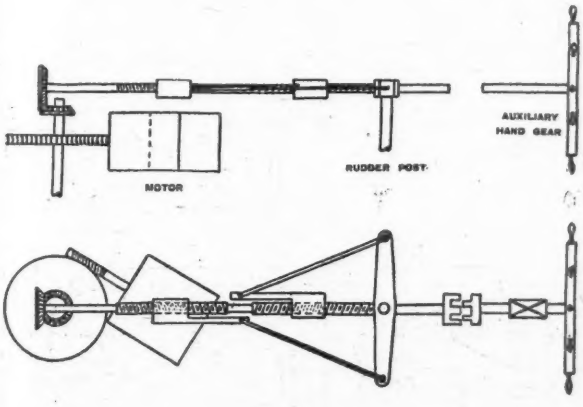

Fig. 3.

drive, more than compensates for any slight increase in total energy consumption. In rough weather, the clutches slip sufficiently to relieve the motor of the worst strains, without in the least sacrificing true and smart steering.

Any good form of electro-magnetic friction clutch should serve this application, the duty being far less severe than that of driving rolling mills, to which such clutches are already applied. In the Brown-Haigh system the clutches are controlled by tele-motors, but this is not inherently essential to their use.

Type of Motor.—On some electrical-steered vessels series motors are employed, but in general compound-wound machines are more suitable. Alternating-current machines are quite inapplicable unless a constantly-running motor be employed. The resistance offered by the rudder varies with $\sin^2 \alpha$ (see fig. 4), so that, for uniform torque, the speed of the motor at various rudder displacements should be arranged to vary with $1/\sin^2 \alpha$. If then the maximum motor speed = N R.P.M. (on just starting from rudder trailing position), the speed at displacement α° should = $(k\,N)$ R.P.M., where k has the values shown in fig. 4.

Actual Installations.—A comparatively large number of vessels have electrically-controlled steam steering gear ; a much smaller number have complete (and independent but interchangeable) electrical and steam steering gear, while a very few ships (among them Russian and German war

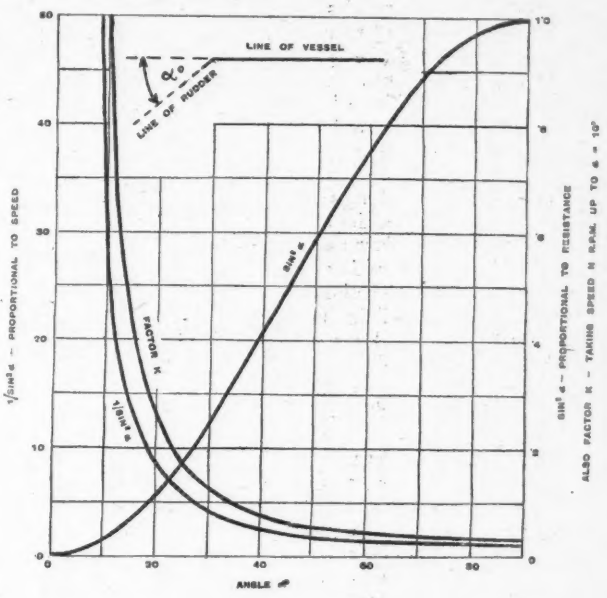

Fig. 4.

vessels) have purely electrical steering equipment. Among the almost historic examples of the former types are the Russian cruisers *Bogatyr* (1901)—electrically-controlled steam gear—and *Rurik* (1907)—complete electric and steam steering gear, and the English vessel *Manxman*, also equipped in duplicate.

CAPITAL AND SINKING FUND.

By "INTERESTED."

In these days when municipal trading is so much in evidence, figures play an all-important part in the business because criticisms are plentiful, and the pros and cons are set forth in many forms by numerous folk all more or less interested in the subject. However, there are not a large number of electricity supply undertakings able to produce accurate records of their early expenditure on capital account, and even now few care to keep a true and proper register of all the plant, &c., consigned to the scrap-heap year by year, or a list of that which has become obsolete. Most of the loans taken up years ago included in each a number of small sums for various purposes, and no true details of the exact amounts expended on various sections of the work such as pipes, pumps, valves, condensers, transformers, switchgear, meters, cables, &c., were recorded. Should an inspector go around the many "juice" works now and endeavour to check with the loan figures the actual material purchased from the commencement, he would have a difficult task before him. I venture to suggest that he would discover many little pieces of the original installations missing, or lying idle unable to serve any useful purpose, increased output or modern improvements having forced it out of commission. The outstanding loans on some of these items may have been redeemed, but I believe there are many things in some works useless as efficient money-earners, yet the capital cost of the same does not look like being wiped off until many years hence. Even if the total of the various small additions paid for out of revenue were set against the value of the missing portions, I think the balance would be found on the wrong side in numerous cases.

In at least one instance, and I expect that not an isolated one, I heard about part of a loan being appropriated for other work than that for which it was originally intended. This tends toward confusion in accounts, and should not be. When trying to arrive at a detailed summary of the capital expenditure in order to compare the same with the different loans, certain discrepancies seemed to appear, and with the delightfully vague information to hand of the early transactions, one could not be quite certain how the money was spent. The conclusion arrived at is that in the early years of municipal enterprise of this kind sufficient care was not exercised in recording full particulars and details of capital expenditure. It is quite possible that the lending authorities are as guilty as the councils in this respect, and the importance of these figures was then not recognised.

Anyway, sufficient information can be gathered from certain quarters to show that in almost every instance where profits from these trading departments have been handed over to the rates, the action was wrong. The proper use of any surplus, after building up a fair reserve fund, is to redeem a few of the smaller loans representing value of plant, &c., scrapped, sold, or which is out of commission owing to various causes. Our public bodies do not yet seem to realise the importance of this subject. They should give it careful and immediate attention. By continuing to take away the profits from the electricity departments for relief of the rates, they are certainly prejudicing their future financial positions. It is so pleasant and easy to pass a resolution commandeering a few thousands now and again from the electricity works, in order to save an extra penny or so on the rates, but is it fair? I hold that hardly one or any station can afford to continue paying away certain sums in this manner whilst they have many outstanding loans on goods which either are not, or soon will not be, able to be used as efficient units in a large generating works. Modern improvements and inventions are responsible for much in this direction, and plant, especially generating plant, is reduced to inactivity in far less time than is suggested when taking up loans. The custom is in many towns to reduce the price of current to a figure which leaves very little for reserve funds, and what little is made certainly should be retained for future requirements, and not lost to the department in the way of relieving rates.

REVIEWS.

Experimental Investigations on the Power Required to Drive Rolling Mills. By J. Puppe. London: Charles Griffin and Co., Ltd. 12s. 6d. net.

A perusal of this book leaves three quite clear impressions on the mind of the English reader. One of these—perhaps the most important—is that, in Germany, they carry out their research work on a comprehensive scale, sparing neither trouble nor expense. Another impression is that the electrical engineer reduces engineering matters to *facts*, by means of exact tests, and does not speculate upon, or guess at, figures. He proceeds to record them. In a word, he carries the scientific spirit into his daily commercial life. That must have—it already has had—a profound effect upon, not only engineering design, but upon engineering commercial methods. Thirdly, the impression of "thoroughness" of the book and all that is connected with it, is given to the reader. It is not only a record of a number of tests, it is an explanation of certain methods. There are descriptions of the rolling mills at which the tests were made. Full details of the instruments employed, and the scheme of the investigations, are given. There are various other technical matters of interest, to which we shall shortly refer.

For the moment we must heartily congratulate Dr. Puppe and all who have been connected with him in his work upon the publication of these records. Hearty and unstinted praise must also be given to the firm of Siemens. Dr. Puppe had the good sense, when he found the resources at his disposal limited, to apply to Mr. Koettgen, of Messrs. Siemens-Schuckert Werke, Berlin, for the loan of suitable instruments. He found a friend indeed. The result of that application seems to have been that the work was lifted from the small compass of a private, or college, research, into the domain of commercial engineering research. It was the union of theory and practice—the latter being supplied by the above-mentioned enterprising and far-seeing firm. They not only supplied the instruments free of charge, but they arranged for a number of engineers from the works to assist in the tests, calculations and compilation of the results. Incidentally, it should be mentioned that the work was originally commenced at the suggestion of Prof. Mathesius, and that the first tests were made with some electrically-driven rolling mills at the Steel Works at Peine. After the tremendous impetus given by Mr. Koettgen (the director of Messrs. Siemens), the scope of the investigation widened so much that in December, 1906, Dr. Puppe solicited the support of the Verein Deutscher Eisenhüttenleute. That society appointed a representative commission and financed the investigations on a most liberal scale. From time to time the commission met and discussed the results obtained. Doubtless the members made many suggestions of a most practical nature.

These facts cause us to ponder over one or two matters outside the title of the book under review, but of the most vital importance to the readers of the Electrical Review. In the first place, we may ask ourselves, would any British firm do for a research—to be made public—what the Berlin firm did? We so frequently read of the good-humoured tolerance of British firms for research work in colleges, how the directors praise our modern Universities in their "off-duty" moments (at public functions), and refuse to employ the college graduate or help the college research-worker. Yet the experience of the present writer is quite the reverse. It is possibly true that firms resent applications for materials from college *students*, but they will readily and generously assist experimentalists of even quite small reputation. During the last two years the writer has been supplied with the equivalent of more than £100 from British firms for a piece of research work which will not directly put sixpence into their pockets. Not only have the firms willingly displayed this generous spirit, but the directors have witnessed the experiments, and have, by private correspondence, displayed deep interest in purely theoretical problems. Again, the question might be asked, Would any English society have stepped in to finance—after its preliminary stages—such work? Most emphatically "Yes!" as witness the excellent and admirable Reports of Researches by the Institution of Mechanical Engineers. That English Institution has made a name by such policy—would that we could say the same for the Institutions of Civil and Electrical Engineers. However, the former seems likely to do something in connection with reinforced concrete; possibly it will take an active interest in other researches in time. The latter does a little work, but not enough, in this direction.

To return to the book; the question of driving rolling mills electrically was first approached about a dozen years ago. There was no reliable information concerning the power required for such work, and the usual muddling "trial by error" and "pious hopes" seem to have been the method of those who designed the power plants. When electric driving was installed, it was quickly realised that, owing to the great facility with which electric power can be measured and recorded, it was a comparatively easy matter to make such tests—and to make them accurately. So important to English steelmakers do Messrs. Siemens of this country think these tests, that they have had the work translated from German into our own language.

It is impossible to give more than quite a brief outline of the many tests recorded. Measurements were made of the power taken by the driving motor and of the momentary speed of the rotating masses; the moments of inertia being known, the energies absorbed by, and given out by, the rotating masses were easily calculated. The choice of instruments and methods employed depended upon the kind of electrical energy—D.C. or A.C. of one, two or three phases—supplied to the driving motor. With the D.C. equipments, both current and voltage were measured by recording instruments. The instruments used with A.C. were dead beat, and are fully described in the book. In order that complete information might be obtained as to the effect of stoppages, commencement of rolling, &c., on the power taken, a suitable

arrangement was so fixed up that certain marks could be made simultaneously from any part of the building. The speed of the rolling mill was simultaneously recorded with the motor output. The chief value of the research from a student's point of view, is this description of instruments. At the same time, the next section—the calculation of the results—is well worthy of close study. A page is devoted to an explanation of the 67 tables, which contain the results of tests with single bars. Then follow three sections, which show (*a*) the influence of temperature on the power required for rolling; (*b*) the influence of the quality of the metal on the power required for rolling; (*c*) the influence of the shape of the groove on the power required for rolling. Each of these problems and their solutions might almost be called a scientific research.

A valuable portion of the book, from the steel-works manager's point of view, is the four pages devoted to general remarks, concerning the selection of the motors and fly-wheels. The work done by the rotating masses expressed as a percentage of the total work depends on the size of the motor and the kinetic energy of the rotating masses. It always decreases—as shown in the power curves figs. 25 to 29—as the length of the bar increases. From one of the diagrams it is clear that 1,450 H.P. was required for the rolling at one period, while the motor used for driving was 381 H.P. This shows how helpful—especially at short passes—are the rotating masses, but they are of less value as the length of the bar increases.

Although a number of useful and interesting deductions from the tests are drawn by the author, yet the reader of initiative will find a great deal of matter in the tables from which much valuable information is obtainable. These tables, indeed, are a quarry from which the practical man will obtain material of money value; while the student and the man of research, will gain the not less valuable inspirations and suggestions which careful and systematic experimental investigations always furnish.

A word of congratulation is due to the publishers. They have produced the new and useful information and diagrams in a manner palatable alike to the young student and the works manager. There is really good value for the money—we have come across books at a guinea which do not contain as much printed matter. Of course, quantity of printed stuff is no merit to the purchaser; it is quality that he wants. But he is naturally pleased when he can obtain a book, which must have been expensive to produce, at a most reasonable price.

We can cordially recommend this most stimulating volume to power engineers, to the managers of steel-works, and to engineering students. No technical library should be without such a splendid work of reference, and such a source of inspiration to young engineers.—C. A. M. Smith.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Municipal Trading.

The discussion on this important subject seems to have a tendency to become personal; its importance ought to be sufficient to prevent this.

On the propriety of municipal trading, there is so much to be said, for and against, that it has produced two widely divided parties in the country, but electrical engineers are, unfortunately, not now concerned with these views of the problem. Since our predecessors sold our birthright when they accepted powers coupled with the accursed condition of compulsory purchase, they handed us over bound and gagged, making it impossible for us to withdraw. That being so, we must devote our energies to the increase of output. Many electricians do not appear to regard the supply of current at a low rate as nearly as important as an adequate supply of pure water, but it is almost so. For the health and well-being of the crowded communities, the entire suppression of all the other methods of obtaining light, heat and power is necessary. Our descendants will probably place the pioneers of cheap electric supply on the same level as Jenner, Simpson and Pasteur.

Taking this view of the situation, surely whatever is likely to provide the more extended use of this beneficent fluid must be supported.

Before deciding what are the correct steps necessary to bring about this result, perhaps an analysis of the trade might be made.

The truth must be told at once. Electrical engineering as a separate profession ends with the designer. The making is mechanical engineering, the generating is mechanical, the switchboard attendant is automatic, the wireman is a plumber or a gasfitter. The factor is a parasite. The business man is the chief but also the kite.

If the municipal supply department take over the whole of the work contemplated, it will still have to buy the plant and accessories, so that the real electrical engineer will not lose at all. The factor would be dispensed with without any tears. The commercial will be wanted, but in any event he can look after himself. The wireman will certainly not be the loser as far as pay is concerned. The amount of work for him should increase largely, because the municipality, being large buyers and certain to pay, will get their supplies cheaper. The loan of motors and heaters and installations will be a great benefit and help to provide work.

The master wireman will still be required, not to the same extent, but the better ones will be necessary to the supply authority, and the others—well, let them go on with the fancy goods and furniture departments. They always say wiring does not pay.

The absorption of the real master wireman will be all to the good; he will replace the present foreman of the meter fixers and connectors-up, and would have priceless opportunities for pushing the uses of electricity.

The facility with which the supply company can obtain a hearing is almost sufficient to warrant the proposed change. Gas would not exist in confinement now if the people could be talked to by a competent master wireman.

A few conditions should, however, be insisted on when the municipal authorities have the powers sought. There should be no vote or pension for the employé, and each of the staff, from the chief downwards, should have served in works as an apprentice for five years and passed some suitable examination, and all wiremen should be obliged to hold a certificate of fitness issued by some such body as the Institution of Electrical Engineers.

The only person at present making a fuss is the master wireman; and, after all, he is usually a painter or seller of fancy silk, glass and metal work. If he is a real master wireman, then he will be wanted; if he is one of the others, he can make a good living out of his shop.

The result will be that the use of electricity will increase rapidly and directly benefit all who ought to have the benefit, and indirectly benefit everybody else by bringing the millennium one step nearer.

Percy Good.

London, S.E., *December 12th*, 1910.

Some Queries in Connection with Heat.

Make two hollow cubes of metal both of exactly the same external dimensions, and the same in every respect except that cube No. 1 has much thicker walls than cube No. 2, so that the former will weigh three times as much as the latter cube. Coat the walls of both cubes with lampblack, so that the heat radiating capacity may be the same in both cases.

If two precisely similar electric heaters are arranged in the centres of the two cubes respectively, and switched into circuit, then the temperature of each cube will rise, until a certain steady temperature, or temperature of equilibrium, is attained.

Obviously the heavy cube will take longer to attain its condition of equilibrium than will the lighter cube, but will the ultimate temperature of equilibrium be the same in both cases?

Can any of your readers inform me as to the origin of the very common fallacy that a mass of matte

maintained at a certain fixed temperature by means of a supply of energy at a much lower rate than was necessary to raise it to that temperature in the first place? How often does one hear it stated, that although it may take a great deal of heat to raise something or other to a certain temperature, nevertheless it will not take much to keep it hot. What is exactly meant by this expression, "a great deal of heat?" It seems to me a very loose expression, and yet I am constantly hearing it made use of by well-informed engineers.

Does it refer to the rate at which the heat energy is applied, or does it refer to the total number of calories supplied, irrespective of time?

Although the above questions may appear to you of a very elementary character, I am, nevertheless, of opinion that their discussion may bring to light some facts of very practical importance, that are, as yet, but too little appreciated, even in the scientific world.

C. Orme Bastian.

London, E.C., *December 12th*, 1910.

Appointment of Canvasser.

I shall be glad if you will allow me to trespass on your valuable space for the purpose of bringing to notice the following:—Comparatively recently I replied to an advertisement of a vacant position with a borough council (value £150 per annum) in the ordinary way, enclosing copies of testimonials, &c. After hearing nothing for a period of three weeks, I received a letter to the effect that the council had decided to re-advertise the position at an increased salary, and that no further application on my part would be considered. It would appear from the foregoing that in all probability the applications received no consideration from the engineer, and consequently it was merely a waste of time to apply. It would be interesting to know if any of your readers have had similar experiences.

H. C.

I am enclosing herewith copies of correspondence that has passed between myself and the officials of the Borough of Hampstead in answer to an advertisement in your paper. This correspondence may be of interest to the public in general, and to the readers of your journal in particular.

The reply of the Borough Council seems to me exceedingly strange, and the sequel will be of much interest, especially to those who, like myself, are precluded from again applying.

Applicant.

[Both these letters refer to the same appointment. The position is sufficiently explained without our printing the correspondence enclosed by "Applicant"—who, judging by his statement of experience, appears to be qualified for a post much superior to that in question. The procedure adopted by the Council is certainly peculiar.—Eds. E.R.]

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

A Waterproof Lamp Joint.

Mr. Barnes Kay, of Haslingden, informs us that he has introduced and provisionally protected a rubber band for slipping over the socket portion of a lampholder, by which means it is claimed that a damp, acid and waterproof joint between lamp and holder is obtained. The arrangement has been successfully used for street lighting and in various works, and the sales agency is held by Messrs. H. A. Jackson & Co., of Caxton Works, Salford.

Oil-Immersed Motor Starters.

Messrs. A. Reyrolle & Co., of Hebburn-on-Tyne, have just put on the market a new line of motor starters, to meet the demand for cheap but reliable accessories of this description. The resistances are wound with wire of a special alloy, and are immersed in oil. All the contacts are under the influence of a powerful blow-out magnet, which at the same time acts as a no-volt coil. The provision of a magnetic blow-out on small starters is, of course, unusual, but the makers are of opinion that it is justified by the small amount of attention required to the contacts. These starters are totally enclosed, as illustrated, and are very suitable

Fig. 1.—Small Motor Starter.

for dusty and wet locations. Up to the present, Messrs. Reyrolle have designed them in two sizes—namely, up to ½ H.P. and up to 2 H.P., for any voltage up to 500; other sizes are being designed.

Lamp Dimmers.

Messrs. Donovan & Co., of 12, Barwick Street, Birmingham, have introduced a patent "dimmer" or resistance switch for turning down lamps in sick rooms, &c., in which graphite is not employed, the resistance element being practically indestructible. One of

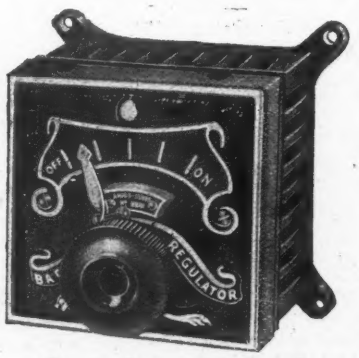

Fig. 2.—Donovan's Dimmer.

these dimmers was recently immersed in water for 48 hours, then taken out and connected in circuit; in a few minutes it regained its full effectiveness, and it now shows no sign of injury.

The accompanying figure shows one of the standard patterns with five steps; the dimmer is made in five sizes, for lamps taking from 50 to 200 watts, A.C. or D.C.

Benjamin Reflector Fittings.

The Benjamin Electric, Ltd., 1A, Rosebery Avenue, E.C., are bringing out a type of fitting of new design for use with high candle-power metal-filament lamps. The reflectors are of vitreous enamelled steel. The porcelain interiors are in two parts, particular

Fig. 3.—Benjamin Reflector

regard being given in the design to secure easy access in wiring and to obtain the widest possible separation and good insulation of current-carrying parts. The reflector fittings are particularly adapted for use in places subject to severe atmospheric conditions or

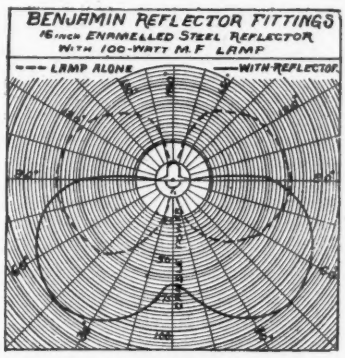

Fig. 4.—Effect of Reflector.

to hard usage. No outer globe is necessary. The fittings are made in three styles, each for a particular purpose. Fig. 3 shows a 300-c.p. lamp with a 16-in. reflector; and curves comparing the light distribution of a 100-watt lamp without a reflector and when used with the 16-in. Benjamin reflector fitting are given in fig. 4.

This fitting is also made with a bowl-shaped reflector (12 in. in diameter) which is especially useful over machinery, &c., and for outside shop-window lighting.

The E.A.C. Automatic Starter.

The Electrical Apparatus Co., Ltd., of Milford Works, Queen's Road, Battersea, S.W., have brought out a new automatic starter, of which the principal feature is the combination of starter and solenoid main switch in one piece of apparatus, actuated by the same solenoid. Its construction and operation are as follows:—Two levers working on the same spindle are held together by a powerful hub spring. The upper lever is attached to the core of the solenoid, and carries the main contactor; the lower arm carries the carbon and copper plungers, which slide over the starting contacts, and is directly attached to the dashpot. When the solenoid

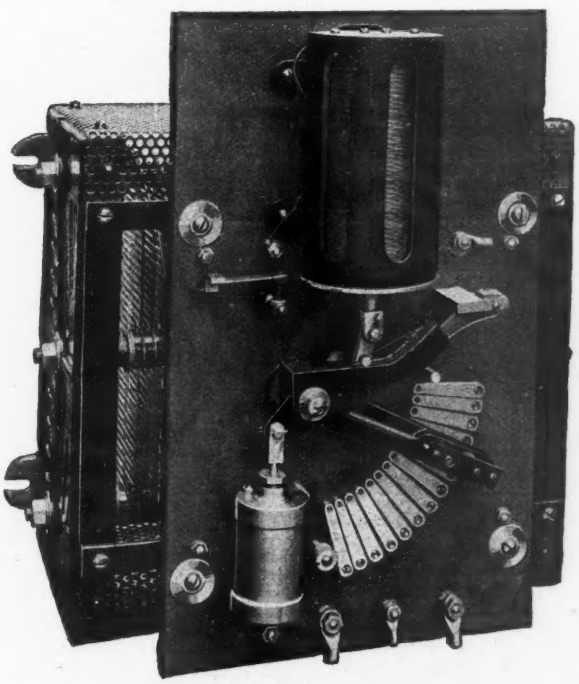

Fig. 5.—E.A.C. Starter.

is energised by closing a tumbler switch, tank switch, or reverser, as the case may be, the upper lever is pulled up with a snap, closing the main contact and starting the motor with all resistance in. The spring between the two levers is now in tension, and the lower lever slowly follows the upper one, being retarded by the dashpot. As it slides over the contacts the starting resistance is gradually cut out until the motor attains full speed. Adjustment is provided in the dashpot to give any desired rate of acceleration.

An important point in connection with the E.A.C. starter is its positive action; this is attained by the use of a very strong solenoid and spring. As the solenoid is only fully energised for about half a second, after which a high resistance is inserted, the operating current is reduced to a negligible quantity. On failure of supply, the solenoid releases the main lever and the circuit is broken, both levers flying back to the "off" position. It will be noticed that the main lever breaks and makes the circuit, and for this purpose is provided with a carbon auxiliary contact and magnetic blow-out. The lever which slides on the contacts never breaks the circuit, and arcing on the contacts is thus avoided; this arcing was formerly a great source of trouble with automatic starters.

In the new E.A.C. automatic starter there is a great saving of space and cost, and at the same time a considerable improvement in efficiency.

Patent Filling Apparatus.

A new filling apparatus, for filling bottles, drums, &c., is being placed on the market under the Alison-Broadhurst patents. In this machine the filling valve cannot be opened until the receptacle to be filled is in the correct position; when it is so placed, the valve automatically opens and delivers the required quantity into the receptacle, the valve closing automatically at the proper time. The machine is fitted with an automatic quick-action scale, which ensures sharp cut-off and accurate weighing, and the mechanism is very simple, so that it is readily mastered by an unskilled workman. The machines are made in several patterns, and are supplied only by Messrs. Wallach Bros., Ltd., of Royal London House, Finsbury Square, E.C.

Christmas Lamps.

The British Westinghouse Electric and Manufacturing Co., Ltd., have introduced a series of candle lamps for Christmas-tree decoration. These lamps give a much better effect than the old-fashioned candles, are infinitely safer, and have the advantage of being free from smell and mess. They will, of course, burn as long as required—a vast improvement over the old candles, which require renewing every hour or so if continuous illumination is desired.

The lamps are sold in sets, each set consisting of 20 11-volt flame-shaped incandescent lamps, with holders and clips for attaching the lamps to the branches of the Christmas-tree. Each holder is provided with flexible connectors, enabling the lamps to be easily connected in series to suit the voltage of the supply. A length of flexible insulated wire and a plug adapter, for fitting to a lamp-holder, are also provided. The lamps can be obtained from the Supply Department of the company at 3, West Street, Charing Cross Road, W.C.

LEGAL.

The British, &c., Automatic Lighting Control Co., Ltd., *v.* Hutchings.

In the Chancery Division before Mr. Justice Swinfen Eady, an action was brought by the British, Foreign and Colonial Automatic Lighting Control Co., Ltd., Holdenhurst Road, Bournemouth, against Mr. William Ernest Hutchings, also of Bournemouth. The plaintiff company claimed an injunction to restrain the defendant for a period of two years from November 21st, 1908, when defendant used to be employed by plaintiffs, from, directly or indirectly, being interested or concerned in the manufacture or sale of any automatic apparatus for controlling the lighting or extinguishing of electric or other street lamps in any town or district in England in which a local authority or electric lighting or gas company were, or had been, the customers of the plaintiffs at or prior to the termination of the defendant's employment by them. They also sought to restrain defendant from soliciting or taking orders for such apparatus under similar circumstances.

Mr. Patterson appeared for the plaintiff company, and said that when a motion was made for an interim injunction, Mr. Owen Thompson appeared for the defendant, but that counsel had been informed that he was not now instructed to appear.

Defendant's name having been called in the Court, and there being no response, Mr. Patterson opened the case.

Evidence was called in support of counsel's statements.

His Lordship held that plaintiffs had proved the breach of the agreement, and were entitled to judgment. Of course, he said, the two years had expired, and therefore plaintiff company did not require the injunction, but they were entitled to damages, and he would grant an inquiry as to those. Plaintiffs would also get the costs of the action.

National Electric Free Wiring Co. *v.* Canterbury Corporation.

The appeal, which was down for hearing in the King's Bench Divisional Court on Thursday, last week, has been withdrawn, the company agreeing to pay the costs of the Corporation. The case arose under a claim by the company against the Corporation for £25 for free-wiring rentals, which, they contended, were due to them under an agreement entered into in 1898. The £25 was due in respect of a house wired by the company at the request of the then occupiers, who signed an agreement to pay the company 1d. per unit of energy used in the house. The occupiers had since died, or ceased through other reasons to occupy the house in question; consequently, none of the wiring rents had been received by the

Council. The company sought, nevertheless, to make the Council liable for the payments. At the hearing the whole agreement was held to be void. This decision will apparently affect, without limitation or distinction, all the existing cases in the City where the Free Wiring Co. have wired houses under that agreement.

The Marconi Patent Case.

In the Chancery Division, Mr. Justice Parker, on Monday last, commenced the hearing of the action of Marconi and Others *v.* The British Radio-Telegraph and Telephone Co., by which the plaintiffs sought an injunction and other relief in respect of an alleged infringement by the defendants of three of their patents.

The plaintiffs were represented by Mr. Astbury, K.C., Mr. Walter, K.C., and Mr. Gray, instructed by Hollams, Son, Coward and Co.; and the defendants by Mr. T. Terrell, K.C., and Mr. Colefax, instructed by Mr. Hudson Matthews.

For the purpose of the trial a complete Marconi installation had been fitted up in the Court, with an aerial wire fixed to an iron ornament on the clock tower.

In opening the case, Mr. Astbury said that Mr. Marconi and his company sought relief for the infringement of three patents that belonged to Mr. Marconi and the company. The patent that they had first to deal with was one known as the four sevens—No. 7,777 of 1900. The other two patents were dated 1902 and 1907 respectively. He would deal first with what had in fact been done by Mr. Marconi's system apart from any scientific explanation as to how it acted, and he would then so far as he was able put the Court in possession of the scientific theory and facts which were necessary and incidental to the system, and would explain exactly what was scientifically known and had been done up to the date of the first patent of Marconi. The four sevens patent was a patent covering the whole consideration, and if it was shown that the defendants had infringed that, there might not be any necessity to deal in detail with the other two.

Mr. Terrell suggested that it might be advisable to deal with the first patent before going into the others.

Mr. Justice Parker said that if the parties liked he would not dispose of the other two until he had given judgment on the first.

Mr. Astbury said he hoped in that case to finish this sittings, but he was not very sanguine. The real difficulty in the case was to understand what they were talking about—what was the language they were using. In the first place, therefore, he proposed to give a very short history of what in fact had been done in relation to the Marconi system. The plaintiff company was formed in 1897, and its managing director was Mr. Marconi. In 1901 an agreement was, for the first time, made between Marconi and the Admiralty, under which the Admiralty took a licence for the use of the Marconi invention. In 1904 an agreement was entered into between the plaintiffs and the Postmaster-General relating to facilities for the collection, transmission and delivery of wireless messages, and by a later agreement it was arranged that the Postmaster-General should acquire, with certain exceptions, the land stations in the country that had been erected for the purpose of sending and receiving wireless messages. To-day the position was that the whole of the land stations in the United Kingdom, with the exception of those of the Marconi Co. at Galway, and Poldhu, in Cornwall, belonged to the Post Office, and they were worked by, or on behalf of, the Post Office. In 1905 a somewhat similar arrangement was made between the plaintiffs, the Board of Trade and the corporation of the Trinity House, and under those agreements the plaintiff company had fitted up wireless stations at various places mainly for lightship installation and for the protection of the coast. In 1903 the increased use of wireless telegraphy led to an international conference at Berne, but no definite arrangement was made at that time, because certain propositions were put forward by other countries that could not be accepted by this. Having, however, regard to the arrangements that had been come to between the Marconi Co. and the Government, and partly for the purpose of enabling an arrangement to be come to with other countries, the Wireless Telegraph Act was passed. By that Act the installation of wireless telegraph apparatus without a licence from the Postmaster-General was forbidden. It was important to notice the terms on which the Postmaster-General's licence was granted. The first condition was that the apparatus must be of the character specified in the schedule of the licence; secondly, the apparatus must be syntonised; thirdly, that all English vessels must be so equipped as to be capable of using a wave length of 300 metres, or so much longer, not exceeding 600 metres, as the Postmaster-General would license. The object of that, said counsel, was that the War Office for the purpose of its battleships used a longer wave length, and the Post Office, acting in conjunction with the War Office, provided that no ordinary merchant ship should use a wave length which should interfere with the War Office wave length. The fourth condition of the licence was that the speed of transmission should not be less than 12 words a minute under ordinary circumstances. In 1896 Mr. Marconi took out his first patent, and it was in fact the first taken out in the world for, or in connection with, wireless wave telegraphy. In England, in 1896, he conducted a series of experiments on Salisbury Plain in the presence of British officers. He then got a message over the distance of 1¾ miles, but in 1897 he covered a distance of 4 miles, which distance, in the same year, was increased to 8 miles in the presence of a German professor named Slaby, whose name might come into prominence in the course of the case. At the end of the year 1897 the first Marconi station was erected in this country, and messages were exchanged over a distance of some 1¼ or 15 miles. In the following year an installation was made between Osborne and the Royal Yacht, enabling Queen Victoria to be in constant communication with her grandson, the then Prince of Wales. By this time the Marconi system had given evidence of becoming a commercially operative process. In 1899 the distances had been largely increased, and the Marconi system had begun to be fitted in British-owned ships. It was fitted on British battleships, the number of land stations was increased, and Marconi apparatus was sent out to the Boer war and used in the field. Also in the same year the Government of the Sandwich Islands had them connected by wireless telegraphy. That was in October, 1899, and the next year was the year of the first patent upon which the plaintiffs were suing. In 1900 the system was approved of by the Nord-Deutsche Lloyd Co., and they had it installed on all their liners. In that year an advance in distance was made to 1,800 miles, and Cornwall was connected with Newfoundland. In 1902, or the following year, the Canadian Government entered into an agreement with the Marconi Co., and from that time onward a number of Marconi stations, about which he need not give particulars, were erected all over the world. In 1904 the Russian Government took up the system, and he believed it was largely used during the Russo-Japanese war. In 1905 the Post Office accepted telegrams for ships at sea, and at the present day every English battleship had adopted the Marconi system. Every large liner had it, and the number of land and ship stations in the country was very large. He now came to the really difficult part of the case, and he proposed to give his Lordship the state of scientific knowledge at the date of the patent, and what the patentee had really done. Now in this great tuning patent a claim was put forward by Marconi under which he was enabled not only to get an enormously greater amount of energy to send messages into space, but was also enabled to combine together in such apparatus two portions, by the combination of which a long and consistent series of waves could be sent out instead of one big wave field. Mr. Marconi invented apparatus which should be a good radiator, and at the same time a good oscillator. Counsel proceeded to explain in detail what he considered ether to be, and said that it was experiments with regard to it that led to the electro-magnetic theory of light. The theory was that the ether waves were the same and obeyed the same laws as light. The necessity for continuity in the waves or oscillations for Marconi's purpose was obvious, because, travelling at the rate of 186,000 miles a second, if one wave was sent a second behind the other, there would be a break of 186,000 miles. That was the knowledge of the world down to 1894. No one had ever attempted to use these waves for the purpose of sending a message. In 1892 Sir William Crookes published an article in which he suggested the possibility of using Hertz waves for telegraphic purposes.

Mr. Astbury was proceeding to refer to an action brought by the Marconi Co. against a wireless company in the United States, but this was objected to by Mr. Terrell.

Mr. Astbury said he only desired to use those proceedings as showing that the patent was then in use in America. Continuing, counsel said that in the year 1894 Sir Oliver Lodge gave a lecture, first in London and then at Oxford, and that lecture was relied upon as an anticipation of the Marconi patents. The lecture was headed, "The Works of Hertz and his Successors." In that lecture Sir Oliver Lodge confined himself to describing Hertz's experiments and Hertz's idea of the physical properties of his electrical waves. He did not suggest, still less show, any means of applying this particular knowledge to wireless telegraphy. All he did was to show by ocular demonstration the existence of these waves. To do this he deflected by means of these waves a galvanometer needle over a distance of two yards. That, counsel submitted, could not in any way be said to anticipate what Mr. Marconi had done. About this time Mr. Marconi was himself making experiments. What he did from the very commencement was to try and apply the existing knowledge for the purpose of transmitting an intelligible message, and nothing of the kind had been attempted before. The coherer used by Sir Oliver Lodge was only two yards away, and was operative to any impulse that would have operated anything. It was perfectly useless for conveying any kind of signal. At the time of Sir Oliver Lodge's lecture Marconi was satisfied that to get an effective signal he must have a transmitter and receiver which were sensitive at a much longer distance than anything that had previously been thought of, and must also have an infinitely more sensitive detector of the ether waves. To do these two things he first of all earthed his aerials. There was some extraordinary connection which no one understood between the earth current and the ether waves. All they knew was that it existed, and test it in whatever way you could, the more perfect the earth conductor was the longer you got your message. Take, for instance, a station in the tropics, where half the year it was absolutely dry and the other half wet. A station with only enough energy to send the messages during the wet part of the year would not send messages during the dry part of the year. What was the interconnection between the two no one knew, but, as a matter of fact, it existed. The energy required to send a message across the sea was less than along a corresponding space of dry land, and everybody knew that the sea was a good conductor. Yet, notwithstanding the enormous advance that had been made since 1896, there were still people in this country who said that Marconi had never invented anything, though his inventions had been accepted in every other country in the world, and in every other country in the world he had been honoured. Mr. Marconi had taken some hidden and difficult scientific facts, and had applied them to the advantage of mankind in a practical way. The second thing which he did was to get his detector, which could at all times detect the presence of the wave.

At the sitting of the Court on Tuesday, Mr. Astbury said that before proceeding with his case he wished to correct a statement that had appeared in the newspapers. Dealing with Sir Oliver Lodge's paper in 1894 on the works of Hertz, he said that in that paper Sir Oliver had not suggested, nor had he contributed anything to, wireless telegraphy. The newspaper had left out the date 1894 and had said that Prof. Lodge had contributed nothing to telegraphy. That, of course, was absurd. After the date of the plaintiffs' first patent in 1896, Sir Oliver Lodge had worked in the field of wireless telegraphy, and had produced a system of wireless telegraphy of his own. Continuing, Counsel said the object of the transformer in the Marconi instrument was to get the reduced current in the aerial. It was not a stepping-up or stepping-down transformer. The real thing that he wanted to do was to get locked together a good radiator with a consistent oscillator. What he wanted to do was to get a consistent oscillating current in the closed circuit. If you got an open circuit controlled by a closed circuit you could force vibration on the open circuit. Tesla had the idea that you could by that means make incandescent lamps glow, and to some extent he succeeded, but that was not Marconi. What Marconi aimed at was persistency of oscillation with sufficient impulse. That was his patent, and there was no question of disconformity. The second patent was for a magnetic detector instead of an ordinary coherer. The defendants' was exactly the same as the plaintiffs' except that they used a double transformer instead of an auto-transformer.

Mr. Terrell said that the defendants' earthing was totally different to the plaintiffs'.

Mr. Astbury said the only difference was that the defendants used an auto-transformer instead of a double-coil transformer. In all other respects, the defendants' was an absolute copy of Marconi's. When Marconi made a detector the defendants copied it.

Mr. Terrell said that was not quite fair. They were not trying the detector case now.

Mr. Astbury said that he was entitled to mention it, because the question was whether there was a detector or a magnetic coherer.

Mr. Terrell said that his case was that either was an anticipation. The defendants said it was not an invention of Marconi's at all.

Mr. Astbury said that he was glad to have that admission. In conclusion, he submitted that Marconi's object was to get a higher frequency and to get more energy than had ever been previously attained, and this he had done. The defendants had taken his invention, and had not made any alteration in it except that they had a different transformer, and he submitted that plaintiffs were entitled to relief.

Mr. James Swinburne was the first witness called for the plaintiffs. Examined by Mr. Walter, he explained in detail the Morse system of signalling, and electromagnetic induction. By induction they could get a wave to pass from one wire to another, but the force decreased so rapidly with the distance to be traversed, that, so far as he knew, induction had never been used for any practical purpose.

(*To be continued.*)

National Electric Construction Co. *v.* The Mayor, &c., of Canterbury.

In the King's Bench Divisional Court, on Thursday, December 8th, before Justices Darling and Bucknill, this case was mentioned. It was a plaintiff's appeal from the decision of Deputy-Judge Haigh, in the Canterbury County Court. Mr. H. J. Robertson, for the appellants, intimated that his clients did not desire to go on with the appeal, and wished to withdraw. Mr. Hohler, K.C., for the other side, asked that, under the circumstances, the appeal should be dismissed, with costs. The Court allowed the appeal to be withdrawn, with costs.

Cleveland and Durham Electric Power Co.

Mr. Justice Neville heard on Tuesday last a petition by this company for a reduction of its capital. The particulars have been fully reported in our "City Notes."

His Lordship sanctioned the reduction as proposed.

PAISLEY DISTRICT TRAMWAYS ARBITRATION.

The following is a copy of the award by Mr. Robert Hammond in this matter :—

"1. That the rates to be paid by the Paisley District Tramways Co. to the Paisley Corporation for the supply of electrical energy for the tramways for a period of seven years from August 16th, 1910, shall be as follows, *videlicet* :—

"For each year of the period a fixed sum of £4 15s. per kilowatt of the maximum power delivered to the tramway feeders during the year and determined as hereinafter mentioned, and, in addition, subject as hereinafter mentioned, a sum of ·475d. (475 thousandths of 1d.) per unit for all units delivered to the tramway feeders and metered at the generating works.

"2. The maximum power delivered to the tramway feeders during any year shall be taken to be the average power delivered to the tramway feeders during that period of 30 consecutive minutes in which the electrical energy supplied to the company is a maximum for the year. And, whereas, in fixing the above prices the Arbiter has, *inter alia*, been guided by the cost of coal and other fuel for the year ended May 15th, 1910. And whereas during such year, as shown by the Corporation's published accounts, the cost of 'coal and other fuel' was £3,294 15s. 3d., and the number of units generated was 3,035,698, and the quantity used on works 408,936 units, and, therefore, the quantity delivered to the feeders 2,626,762 units, and the resultant cost per unit delivered to the feeders was ·301d., he further awards and directs that the aforesaid ·475d. per unit payable by the Tramway Co. shall in each year be increased or decreased as the case may be by an amount equal to the difference between the actual cost per unit delivered to the feeders of 'coal and other fuel' to the Corporation in that year and ·301d. per unit.

"The Arbiter also directs that, pending the determination of the amount of the maximum power and of the coal cost each year, monthly payments on account shall be made by the company to the Corporation as follows :—£275 in respect of the KW. charge. ·475d. (475 thousandths of 1d.) per unit for all units supplied, and the necessary adjustments of the account shall be made at the end of each complete year.

"For the determination of the average power referred to above, the Arbiter has assumed that an integrating wattmeter will be employed, so arranged with auxiliary mechanism, that it will automatically record the maximum consumption of electrical energy during periods of 30 consecutive minutes, the number of KW. of average power being twice the number of units so recorded."

BUSINESS NOTES.

Our Issue of December 30th—Notice to Advertisers.—Will advertisers kindly take special note of the announcement appearing on page 9 (Supplement) of this issue? Owing to the Christmas Holidays new copy and alterations to existing displayed advertisements will require to be in the hands of our Advertisement Department by the morning of *Friday, December 23rd.*

"Onewatt" Lamps.—Messrs. Siemens Brothers Dynamo Works, Ltd., Tyssen Street, Dalston, N.E., advise us that they are shortly placing on the market a range of 50-C.P. "Onewatt" lamps for 100 to 130 and 200 to 250-volt circuits, for street lighting only. We understand that these lamps will be of the same high quality as the other types of "Onewatt" lamps already placed upon the market by Messrs. Siemens, who are making a speciality of street-lighting schemes with high efficiency drawn-wire tungsten lamps of the "Onewatt" type, as will be seen from our "Contracts Closed" columns.

Bowling Green Lighting.—An enterprising hotel keeper at Redditch has had his bowling green illuminated by means of high candle-power "Osram" lamps, to enable patrons to continue their play after dark, and, naturally, the idea has proved a very popular one. Ample light for the purpose is obtained by means of five 200-C.P. lamps, suspended from bracket arms attached to scaffold poles, one at each corner of the green and one suspended from the centre of a steel wire stretched right across the green. The wire is carried round the sides of the green on insulators and controlled by a D.P. switch and fuses fixed by the door leading from the hotel. The green, which measures 45 yds. × 25 yds., is well illuminated.

"Arcoflame" Lamps.—Messrs. J. & H. Grevener, Eldon Street House, E.C., announce a number of improvements and new features in their "Arcoflame" lamp. The A.C. lamp is fitted with a single electromagnetic cut-out which cuts the lamp completely out of circuit immediately the main current fails from any reason. The friction-clutch in the gear is also claimed to be a decided advantage. The D.C. lamp is mounted with a substitutional resistance complete with the lamp, and is actuated by an improved type of contact which is understood to be safe and certain in action. An arrangement for overcoming carbon trapping is also a notable feature.

Faraday House.—We have received from the Electrical Standardising, Testing and Training Institution, Southampton Row, W.C., a copy of the scale of fees for their testing department, which has just been issued. Some pictures appear of the standardising room, the machine tools workshop, and the engine room, at Faraday House.

Enterprise in Hungary.—It is mentioned in the report for 1909-10 of the Telephon Fabrik, formerly J. Berliner, that the development of the company's Hungarian undertaking makes it desirable that an independent company should be formed in Hungary. A few days before this report was published a Berlin newspaper announced the proposed establishment of a Hungarian company, with a share capital of from £62,000 to £83,000 for this purpose, and it is suggested that the explanation is afforded out of consideration for contracts to be allocated by Hungarian telephone and railway authorities.

Buenos Ayres Awards.—The exhibit which MESSRS. A. REYROLLE & CO., LTD., had on the stand of their Buenos Ayres agents at the "Railway and Land Transport" Exhibition, Buenos Ayres, has been awarded a Diploma of Honour.

Correction.—Our readers have probably observed a slight printers' error—the dropping of a decimal point, which makes all the difference in the world—in the advertisement of MESSRS. SIEMENS BROS. & CO., LTD., appearing on page 23 of our advertisement supplement last week. The switchboard instruments there shown, are, of course, accurate within 1·5 (1½) per cent., not 15 per cent.

Catalogues and Lists.—MESSRS. A. P. LUNDBERG AND SONS, 477-487, Liverpool Road, Islington, N.—Revised illustrated price list, S 26 (10 pages), in their usual form, describing their "Pivot" tumbler switch and particularising a new "Reliable" push-button "pivot" switch. Also list S 25 (revised), of 10 pages, relating to "Pivot" intermediate switches.

THE CRYPTO ELECTRICAL CO., 155/159, Bermondsey Street, London, S.E.—Descriptive priced circular of their D.C. rotary transformer for lighting cinematograph arc lamps.

THE KEY ENGINEERING CO., LTD., 4, Queen Victoria Street, London, E.C.—36-page booklet containing full particulars of the constructional details of Erhardt & Sehmer double-acting four-cycle gas engines.

MESSRS. W. H. PALFREYMAN & CO., 17, Goree-Piazzas, Liverpool.—Card drawing attention to their hydro-carbonated bone-black for case-hardening.

MESSRS. WARD & GOLDSTONE, Sampson Works, Salford, Manchester.—New price list of a number of "lines of safety." These include a new Board of Trade hand-lamp for domestic purposes, being of a lighter pattern than their "Guardian" type. The "Handshield" plugs are particularised, also the "Isogrip" workshop flexible cord, and the "Isogrip" lampholder. The "Guardian" pendant holder is likewise listed, and the firm are also supplying tumbler switches mounted in or on iron boxes with exposed earthing device.

THE NORTH-WESTERN ELECTRICAL APPLIANCE CO., Cathcart, Glasgow.—New price list of the North-Western arc lamp lowering gears, winches, &c., which we understand have been adopted by the Admiralty and have a steadily increasing sale both at home and in the Colonies. A large sheet of illustrations of the gear brings out the essential parts by means of colouring.

THE OERLIKON CO.'s British and Colonial Office (Mr. G. Wüthrich), Oswaldestre House, Norfolk Street, London, W.C.—Illustrated leaflet describing the Oerlikon three-phase enclosed motors with forced ventilation.

MESSRS. W. LILEY & CO., 18, Renshaw Street, Liverpool.—A number of blotter cards for the desk.

THE BRITISH PROMETHEUS CO., LTD., Salop Street Works, Highgate, Birmingham.—Priced cards showing two of their new designs of electric radiators and convectors. One is a convector constructed in cast-iron, finished matt black, and having a loading of 1,000 watts. It is fitted up on the "Prometheus" strip system. The other is a luminous radiator constructed in wrought iron, matt black finish. In this radiator no switches are provided, the wiring being done direct to the lampholders. Both of the foregoing are exceptionally cheap lines.

MESSRS. JOHN J. GRIFFIN & SONS, LTD., Kingsway, London, W.C.—"Griffin's Scientific Handicraft" is the title of a large and imposing volume of over 1,000 pages, in which are profusely and clearly illustrated, briefly described, and clearly priced, an enormous variety of scientific apparatus manufactured and sold by the Messrs. Griffin. We cannot pretend to do more than indicate in a general sort of way the nature of the contents. The book is divided up into three parts. Part I covers such things as laboratory furniture, measuring apparatus, microscopes, apparatus for applied mechanics, wood and metal working tools, drawing instruments, engine indicators, &c. Part II is sub-divided into two sections particularising apparatus for sound and heat students and investigators. Part III is also sub-divided, its respective sections covering apparatus for (*a*) frictional electricity, (*b*) magnetism, (*c*) voltaic electricity. The last sub-section alone occupies some 300 pages, and it is concerned with such things as battery material, measuring instruments, condensers, selenium cells, bells, telephones, telegraphs and wireless telegraphy, lamps, electrochemical apparatus, electro-plating apparatus, electric furnaces, electric heating apparatus, electro-medical apparatus, X-ray apparatus, Tesla apparatus, and so on.

MESSRS. HOME & ROWLAND, Troughton Road, Charlton, Kent.—Calendar for 1911 with tear-off monthly slips. A couple of circular prints in colour enable one to contrast the old H.M.S. *Victory* with the modern *Dreadnought*.

MESSRS. ALDOUS & CAMPBELL, LTD., 21, Lower Bland Street, Great Dover Street, London, S.E.—We have received a new series of "blotters" issued by the firm, showing their works and some of the lifts supplied by them, including electric push-button control passenger lifts, electric goods lifts, and electric service lifts, and drawing attention to their inspection and maintenance department.

THE ELECTRICAL AND ENGINEERING SUPPLIES CO., LTD., 36-37, Upper Thames Street, London, E.C.—A number of leaflets. One is particularly timely as it describes, illustrates, and states prices of, decorative outfits particularly suitable for lighting Christmas trees, and for shop window displays. All the live parts are entirely enclosed and can be sent out ready wired for putting in position at a moment's notice. One type is fitted with candle lamps. Copies of the circular can be obtained by any firm in the trade. Other lists received show electric flashing signs, electrically illuminated wooden letter signs, and so on.

MESSRS. SIEMENS BROS. DYNAMO WORKS, LTD., Dalston, N.E.—Eight-page pamphlet dealing with tantalum electric lamps and Holophane reflectors and fittings. Illustrations are included of a few installations in which tantalum and "Onewatt" lamps are used in conjunction with Holophane glass ware.

THE GRONDAL KJELLIN CO., LTD., 20, Abchurch Lane, London, E.C.—Leaflet describing with drawings their Paragon electric steel furnace.

THE PEEL-CONNER TELEPHONE WORKS, LTD., Midland Bank Chambers, Queen Victoria Street, London, E.C.—No. 1 Bulletin (52 pages) just issued by this company forms the first part of a complete text-book, which is intended to cover the whole field of telephony, that will be published by them in a number of sections, for the set of which a stiff binder will be prepared. The bulletin before us is excellently produced, with half-tone illustrations of a high class printed on art paper. It is not only an illustrated list of the Peel-Conner standard manufactures, with corresponding code numbers, code-words, weights, measurements, and diagrams of the various circuits, but it is also a treatise on the subject of magneto call telephones, with a description and illustration of each component part. The "Strongphone," the "Shortphone," the "Amalgaphone," magneto desk phones, extension bells, switches, transmitters, receivers, lightning arresters, and a lot of "little things that count," are all well set out in the pamphlet.

Book Notices.—*Who's Who*, 1911 (10s. net); *The Englishwoman's Year Book*, 1911 (2s. 6d. net); *The Writers' and Artists' Year Book*, 1911 (1s. net). London: Adam and Charles Black.—In *Who's Who* we have one of the most useful annuals. We do not think we have ever looked in it for information that ought to have been there without finding it, and we have it in our hands many times in the course of a year. It is, in our estimation, the only production of its kind, and no library for men of affairs, and only those offices which do a very circumscribed sort of business, can exist for long without needing to know some of the things that are recorded here concerning leaders and others in almost every walk of life. In these days the *Englishwoman's Year Book* must be enjoying a greatly increased patronage, for it is full of many of those things which every woman ought to know in regard to education, professions, gardening, art, music, sports, philanthropic organisations, women's societies, and so on. The *Writers' and Artists' Year Book* gives a good deal of information that should be serviceable to those who have MS. and illustrations for disposal, and want to know where they are likely to be acceptable, and about what they will get for them—if accepted.

"The Distington Multiple Boiler Explosion and other Multiple Boiler Explosions." By Edward G. Hiller. Manchester: The National Boiler and General Insurance Co., Ltd. Price 1s.

"The *Physical Review*." Vol. XXXI, No. 5. November, 1910. Lancaster, Pa.: The Physical Society. 65 cents.

"Annuaire International de l'Acétyléne, 1910-11." Paris: l'Office Central de l'Acétylene. Price 3 fr.

"Cours Elementaire d'Electricité Industrielle." By P. Roberjot. 1911. Paris: H. Dunod and E. Pinat. Price 4 fr. 50.

"Introduction à l'Etablissement des Lignes Aériennes de Transport d'Energie Electrique." By Octave Cahen. 1910. Paris: Dunod & Pinat. Price 9 fr.

"Generatrices de Courants et Moteurs Electriques." By C. Gutton. 1911. Paris: Dunod & Pinat. Price 10 fr. 50.

"Il Nuovo Cimento." October, 1910. Pisa: Società Italiana di Fisica.

"*Bulletin* Scientifique de l'Association des Elèves des Ecoles Speciales." November, 1910. Liége: Imprimerie Moderne.

"Dynamo-Electric Machinery, Direct-Current Machines." By Samuel Sheldon and Erich Hausmann. London: Crosby Lockwood and Son. Price 10s. 6d. net.

"Electric Motors." By F. B. Crocker and Morton Arendt. 1911. London: Crosby Lockwood & Son. Price 10s. 6d. net.

"Principles of Wireless Telegraphy." By G. W. Pierce. 1910. London: Hill Publishing Co., Ltd. Price 12s. 6d. net.

"The M.C.C. Chart of the Elements." Published by the Metallic Compositions Co., 333, Gray's Inn Road, W.C. Price 5s. (unmounted), 8s. 6d. (mounted on linen).

Dissolutions and Liquidations.—THE MICA MANUFACTURING CO., LTD.—This company is winding up voluntarily, with Mr. J. S. Porter, Eldon Street House, E.C., as liquidator. A meeting of creditors will be held on December 21st.

CHICHESTER AND DISTRICT ELECTRIC SUPPLY CO., LTD.—A meeting is called for January 13th, 1911, at Electrical Federation Offices, Kingsway, W.C., to hear an account of the winding up from the liquidator, Mr. H. A. Stagg.

ROBINSON, BOWMAN & CO., 17, Houghton Street, Liverpool, dealers in electrical fittings, brassware, hardware, &c.—Messrs. J. A. Robinson and S. Bowman have dissolved partnership. Mr. Robinson will attend to debts, and the business in future will be separately conducted by the respective partners named.

THE WEST CROYDON ENGINEERING CO., motor, electrical and general engineers, St. Michael's Road, West Croydon.—Messrs. E. Strutt and G. H. Gardner have dissolved partnership. Mr. Strutt attends to debts.

MESSRS. FOZARD & HEWITT, electrical agents and engineers and textile machine agents, Springwood Avenue, West Bowling, Bradford.—Messrs F. Fozard and F. T. Hewitt have dissolved partnership. Mr. Fozard attends to debts and will continue the business under the same style.

Trade Announcements.—THE HAGEN ACCUMULATOR WORKS on Monday last removed their offices to Kimberley House, 15, Holborn Viaduct, London, E.C. Their telephone number remains unaltered (12,832 Central).

THE CRYPTO ELECTRICAL CO., of Bermondsey Street, S.E., announce that owing to the rapid expansion of their business they

have again enlarged their factory, having outgrown their present accommodation, despite the fact that an addition was made just over a year ago of about 50 per cent. to their then available space. This is the fourth occasion during the last six years that accommodation has had to be increased. The firm's numbers in Bermondsey Street will be in future, 149, 155, 157 and 159.

MR. W. H. CLEGG, A.M.Inst.C.E.I., who has been with the Edison & Swan United Electric Light Co., Ltd., as District Superintendent at their Leeds Depôt for the past three years, has resigned to take up the position of commercial and sales manager of the Adams Watkin Co., Ltd.

MESSRS. DORMAN & SMITH have appointed Mr. F. A. Leonard as their representative for Lancashire, Yorkshire, Cheshire, Derbyshire and Nottinghamshire.

To Instrument Makers.—Mr. T. V. d'Ornellas, 15, Calle de Lima, Chorillos, Lima, Peru, in the course of a recent interview with an engineer from this country, said he would like to have catalogues of experimental, testing and scientific instruments, including oscillographs. He is consulting engineer to the Government, and has previously bought these elsewhere, not knowing that they were made in England of sufficient sensitiveness. We are sure that our well-known electrical and scientific instrument makers are not going to let one day more pass without putting their best and most effective literature, suitable for Mr. d'Ornellas's purpose, into the mail.

Bankruptcy Proceedings.—MR. GEORGE PEARSON, Abbott Road, Poplar, and Southend-on-Sea.—The public examination was held last week at the London Bankruptcy Court before Mr. Registrar Brougham. Accounts have been lodged showing liabilities £637, and assets consisting of £400 shares in G. Pearson and Sons, Ltd., returned as of uncertain value. In reply to Mr. Walter Boyle, Assistant Official Receiver, the debtor stated that in 1902 he became interested in a patent electric battery, and in April of that year he formed "The London Electrical Syndicate, Ltd.," with a nominal capital of £2,000; he was allotted £500 ordinary shares, with the appointment of managing director at a salary of £500 a year. When the batteries were placed on the market, many of them were found to be defective, and had to be called in, with the result that the company was wound up in September, 1907. The assets were purchased for £455 by his three sons, who continued the business under the style of "Pearsons," and employed him as manager at a salary of £400 a year. In January last the business was sold to a company registered as "G. Pearson & Sons, Ltd.," with a capital of £2,000; witness was allotted £400 shares of the company, and was appointed managing director at the same salary as before, which position he held at the date of the receiving order. In February he commenced to speculate in rubber shares, and after two months one of his brokers closed his account with a loss of £211, for which he obtained judgment in September last, and subsequently filed the petition upon which the receiving order was made. Witness attributed his failure and insolvency to losses on the Stock Exchange. The examination was concluded.

W. G. EVERINGHAM, electrician, 37, Auckland Road, Ilford.—December 28th is the last day for receipt of proofs for intended dividend. Trustee, Mr. C. Mercer, Official Receiver, 14, Bedford Row, London, W.C.

A. E. FELGATE and W. STOREY, electrical engineers, Reading.—A first and final dividend of 7d. in the £ is payable December 29th, at 2, Forbury, Reading.

CHARLES HELLYER PEARSON, trading as Pearson & Co., at 51A, Mosley Street, and as the "B.O.A." Engineering Co., at Stockton Street, Manchester; and as Pearson & Co., at 4, Manchester Road, Hyde, electrical engineer, &c.—A receiving order has been made on the debtor's own petition in the Manchester County Court. Recently a private meeting of the creditors was held when the bulk of those represented were in favour of accepting a composition of 10s. in the £. One of the largest creditors, however, would not agree, and consequently the debtor filed his petition. The liabilities amount to about £2,798, and the assets to a little over £1,000.

LIGHTING and POWER NOTES.

Argentina.—It is reported from Berlin that a Mr. Folpatti has applied for a concession for an electricity supply undertaking in Buenos Ayres, where the German Transmarine Electricity Co. practically controls the situation from the supply point of view, for lighting and tramway purposes. At the same time the German company does not possess a monopoly, and it is this fact which has always caused it to be prepared for rival efforts, which are not regarded by the company as being dangerous, owing to the strong position occupied by the latter and to the local conditions. This is said to be particularly the case in respect of the new proposal for a concession, as in several of its principal points it only repeats the conditions embodied in the German concession, and as a practical and legal adviser of the town, to which the applicant has offered a comparatively small deposit, is declared to have suggested that the concession should not be granted. Apart from this question, the German company continues to proceed with new schemes of extension in Buenos Ayres and in other places, and it is expected that a large issue of fresh capital will be made in connection with these developments in the course of the next few months.

Australia.—The electric supply department of the Sydney Corporation is finding the Balmain Light and Power Supply Corporation a keen competitor in connection with the supply of current to the suburban municipalities. So far the city authorities have only been able to arrange with Annandale, whereas the private company has long term contracts, up to 50 years, with Petersham, Newtown and Glebe. Whatever may be the feeling between the two supply undertakings, it is at least satisfactory to see the area in which electric current is available rapidly extending.—*Australian Mining and Engineering Review.*

Ballyclare.—On the evening of the 10th inst., the electric lighting scheme was carried to completion. The contractors, Messrs. Curran Bros., Belfast, invited a large company to the generating station to witness the switching-on ceremony.

Bognor.—The question of rescinding its application for a prov. order for E.L., and instead, supporting the application for an order by the Chichester Electric Light Co., has been deferred by the U.D.C. pending the receipt of the terms proposed by the company.

Bradford.—The T.C. has applied for a loan of £60,000 for mains extensions, &c.

Bridgend.—The U.D.C. has decided to lay mains in the Cowbridge Road district, and to erect a sub-station to supply that area. Extensions to the public electric lighting are also to be proceeded with in several new streets immediately.

Bridlington.—With reference to the proposal to open an electrical showroom, the T.C. has decided that the Electricity Sub-Committee shall discuss the matter with the electrical contractors of the town.

Continental Notes.—GERMANY.—A novel strike is reported to be in progress at Bamberg. The electricity supply undertaking is in the hands of the municipal authorities, and the usual charge for a supply of current is 70 pfennigs (about 8¾d.) per KW.-hour. It recently leaked out that one large shopkeeper had secured a reduction to 50 pfennigs (6d.), and as the authorities have declined to supply other shopkeepers in the town at less than 60 pfennigs (7½d.), they have gone on strike, they having as a body, decided not to use electricity for the illumination of their premises until they are granted the same terms as the favoured shopowner.

Croydon.—The Lighting and Electricity Committee of the B.C., on Monday recommended a change from gas to electric lighting in six roads. Councillor C. Hussey (chairman of Croydon Gas Co.) asked that when this was done the number of gas lamps displaced should be stated. Alderman Betteridge said the figures would be quite misleading, for it had been decided to reduce the distance between each lamp in the side streets from 90 to 75 yds. Where gas lamps were changed to a larger number of electric incandescents, the Committee was simply carrying out its new policy for improved lighting, and it must not be inferred that more electric lamps were needed to give the same amount of light as gas.

Crook.—The U.D.C. has accepted the tender of Messrs. Pease & Partners for seven lamps, with poles, wires, &c., for lighting Stanley Colliery village, at £29.

Dewsbury.—The Yorkshire Electric Power Co. has applied to the T.C. for permission to supply current for lighting to consumers at Ravensthorpe who are already supplied with energy for power.

Dorking.—Permission has been given by the U.D.C. for cable extensions to Boxlands and to the Westhumble district. When the work is completed, a big increase in the number of consumers is expected.

Dover.—The T.C. has decided to extend the lighting mains to River by means of overhead lines on the tramway poles.

Dungiven.—The inhabitants of this County Londonderry town have been considering a scheme for the electrical lighting of the place. The other night a meeting was held in this connection, and a scheme was submitted by Mr. A. Semple, J.P., who proposed to generate the current at his mill premises for the private lighting of the houses of the town. The meeting was adjourned to consider the scheme being amalgamated with one for the public lighting of the town.

Durrow.—A complete electric light installation is at present being carried out at Durrow Abbey, the residence of Mr. Otway Graham Toler. The installation consists of over 150 lights with a direct-coupled generating set. The work is being carried out by Messrs. Mecreedy, Eaton & Davidson, Dublin.

Dysart.—The T.C., after discussion, resolved to consent to the Fife Tramway, Light and Power Co.'s application for a provisional order for electric lighting within an area including the burgh of Dysart.

Fareham.—The expenditure on the new electricity works having been £550 less than the loan sanctioned, the U.D.C. has applied for permission to use the balance for the provision of a feeder main from the station and for the house services. The expenditure on the new works is as under: Buildings and generating plant, £7,153; other expenditure, £1,062; public lighting, approximately, £450; mains £495.

Felixstowe.—The Suffolk Electricity Supply Co. has decided to reduce the price of energy for the nine winter months from 6½d. to 6d. per unit, subject to there being no arrears and to accounts being promptly paid.

Folkestone.—The T.C. has decided to purchase energy from the Electricity Supply Co., Ltd., for lighting the Library, &c., at a flat rate of 4¾d. per unit.

Gillingham (Kent).—The T.C. has passed a resolution "That the electrical engineer carry out all necessary electrical work in connection with municipal buildings where he can, and if he is not able to do so, that he put out the work in consultation with the chairman of the E.L. Committee."

The T.C. has received from the L.G.B. sanction to loans of £2,000 for mains and £1,500 for services, sub-stations, and transformers.

Glasgow.—At a meeting of the T.C.'s Sub-committee on Electricity Finance, the treasurer reported that the unexhausted borrowing powers of the Electricity Department as at that date amounted to £15,000, that the amount which the Corporation had obtained authority to borrow was £2,000,000, and that it would be necessary to make application to the Secretary for Scotland for consent to borrow a further sum. The Sub-Committee, after consideration, remitted to the engineer and the treasurer to prepare and submit a statement showing the sum required to meet capital expenditure in the immediate future.

In connection with next year's Scottish Exhibition of Natural History, Art and Industry in Glasgow, it has been reported to the T.C.'s Electricity Committee that for the purpose of supplying the Exhibition with electricity it would be necessary to put down special transforming plant, and that offers had been received by the Exhibition authorities from several firms who agreed to install the plant as an exhibit. The lowest offer was that of the British Westinghouse Co., which was on the following conditions:—That the Glasgow T.C. agree to purchase the plant at the termination of the Exhibition, at the price of £4,805, which was considerably less than cost, but only at such times as the T.C.'s requirements in the way of extensions might necessitate, the price not to be paid until the plant was installed in one of the generating or sub-stations; that the plant shall be entirely to the specification and approval of the engineer of the Corporation electricity department; and that, if only part of the plant was taken over to begin with, the payment shall be *pro rata* of the lump sum of £4,805. The engineer stated that at least one-half of the plant would be required next winter, and that the acceptance of the offer would save the Corporation the expense and trouble of removing transforming plant from one of the generating stations to the Exhibition and of taking it back again towards the end of October, at a time when it might be too late to be of use for the next winter's load. The Committee agreed, in the event of the Exhibition authorities accepting the offer by the Westinghouse Co., to recommend the Corporation to purchase the plant upon the terms mentioned.

The financial statement in connection with the recent Smoke Abatement Exhibition, in which the T.C.'s electricity and gas departments were the principal factors, has now been issued, and shows that there was a total number of visitors of 69,010; and that the net surplus was £1,045. Of the surplus, sums of £200 are to be paid to each of the departments mentioned on account of the outlays incurred.

Last week through the breakdown of a H.T. trunk feeder—according to the local papers, one connecting Port Dundas and Pinkston power stations—the central district of the city and other portions were deprived of the electric supply for about half an hour. All the city sub-stations are reported to have been shut down, but the Kelvinside area was unaffected. On the south side the supply from the St. Andrew's Cross station was restored in 10 minutes.

Golborne.—With regard to the extension of the mains to Golborne from the nearest point, a distance of five or six miles, the Lancashire Electric Power Co. has informed the U.D.C. that the capital cost would be from £10,000 to £15,000 and subject to a guarantee for seven years to the extent of 20 per cent. on the capital cost, it would be prepared to supply energy in bulk at the following prices:—A fixed charge of £6 per annum per KW. for the first 100 KW. of maximum demand; £5 per KW. for the second 100; £4 10s. per KW. for the third; £3 10s. per KW. for the fourth; and £3 per KW. above 500, and in addition a charge of ·45d. per unit delivered. The Council has decided to seek expert advice on the terms.

Hastings.—The proposal of the Hastings Guardians to substitute electric lighting for gas at their workhouse premises continues to excite considerable opposition. The cost of installation will be about £500, and the Corporation requires a loan for the laying of the necessary cable. The Guardians propose to borrow for five years, and agree to enter into a five years' agreement for the supply of electricity with the Corporation. The Ratepayers' Association, at a meeting held a few days ago, decided to urge the L.G.B. to refuse a loan on the ground that some eight years ago, when the new workhouse was built, considerable expense was incurred in gas fittings. The Gas Co. naturally is opposing as "large ratepayers." In view of the success which attended the opposition of the Gas Co. to a loan which the Corporation desired for the conversion of gas lamps (which work has since been carried out in instalments out of current rates), it is just on the cards that the whole scheme (in which Guardians and Corporation are co-operating) for "buying at their own shop" may be upset.

Heston and Isleworth.—On Wednesday, Mr. Geo. Gentry, the chairman of the U.D.C. Electricity Committee, started the new machinery at the Council's electricity works. The building has been doubled in size and the plant has been increased 50 per cent.

Killeshandra (County Cavan).—At a meeting of the Lighting Committee recently, it was decided to light the town by electricity, and the contract for doing the same was given to Mr. Fletcher.

Leominster.—Mr. J. H. Edwards, of Bristol, has informed the T.C. that he is applying for a prov. order for E.L.

London.—MARYLEBONE.—The accounts for the quarter ended September 30th show that the revenue from the sale of current during the three months to private consumers came to £20,490, as against £19,817 in the corresponding period of 1909, the rental from meters during the two periods being respectively £1,525 and £1,429. The increase over the number of units sold in the corresponding period of last year totalled 251,980. The department has now had a complete 12 months' experience of the "telephone system" of charging, although during the December quarter of last year, it only applied to certain large consumers. In these particular cases, however, it was known that the immediate effect would be to substantially reduce the income of the undertaking, the benefit being to secure with these important consumers valuable contracts for terms of years, in addition to a probable gradual increase of the use of electricity for purposes other than lighting. The gross income for the quarter from all sources was £27,756, against £22,826 for last September. Two items were primarily responsible for this increase, viz., the larger public lighting income, and the substantial turnover of the Sales Department. Notwithstanding the increased output, the total expenditure on production, distribution, management, &c., was only £10,276, as against £9,745, and £10,000 for the corresponding periods in 1909 and 1908. The result of the operations of the Sales Department during the quarter was considered most satisfactory. The expenditure was £1,344, and the income £1,166, showing a net debit of £177, as compared with a net debit of £509 in the previous quarter.

The L.C.C. in 1907 served notices on the Islington and Marylebone B.C.'s requiring them to provide testing stations in accordance with the provisions of their E.L. orders. Since that time considerable negotiations have taken place and the Council having come to the conclusion that these B.C.'s do not intend to comply with the notices, has decided to take proceedings to enforce its requirements. The Highways Committee says:—"We may state that the question of the establishment of testing stations was initiated about eight years ago by some of the metropolitan borough councils, who pressed for the provision of these stations for the purpose of testing the electrical energy supplied by companies in their respective areas. When the companies were accordingly approached in the matter, they naturally suggested that the establishment of testing stations by metropolitan borough councils owning electricity undertakings was equally necessary and fair in accordance with the terms of their respective orders, in order that consumers should be protected whether taking a supply from a borough council or from a company. In this connection it is interesting to note that the notices served by the Council on electric supply companies to establish testing stations have been given effect to in every case, whereas, out of the notices served upon the whole of the 14 B.C.'s owning electricity undertakings, only in three cases—Poplar, Stoke Newington and Woolwich—have the Council's requirements been actually complied with up to the present time."

HAMMERSMITH.—The Electricity Committee having reported that the balance (£5,429) of the loan sanctioned in July last for £10,666 for the purpose of the undertaking would be required at an early date, application is to be made to the L.C.C. for the advance of the money.

ISLINGTON.—The Lighting Committee reports having for some time past had under consideration the necessity for further developing the business of the electric lighting undertaking, and to effect this it has prepared a scheme for contract lighting and for the hiring out of motors, radiators, irons, fans and other electrical accessories. It is not proposed to reduce the cost of current, and in every respect the charges will show a profit to the undertaking, whilst still permitting exceptionally favourable terms to be offered to prospective consumers. The scheme will be so worked that practically no liability as regards the purchase of materials and accessories will be undertaken by the Council unless business is obtained, and in these circumstances, in the first instance, a sum of £500 only will be sufficient to enable operations to be commenced.

Loughborough.—The half-yearly report of the electricity department shows a profit of £388, against a loss of £144 for the same period last year.

Maldens and Coombe.—The B. of T. has revoked the 1907 E.L. order.

Oldham.—The T.C. has again asked the B. of T. to grant one order so as to enable energy to be supplied to Chadderton, Royton, and Limehurst, where there are 40 applicants for a supply.

The question of supplying energy to small houses at 6d. per week, as at Eccles, is to be considered.

Pontypridd.—The U.D.C. proposes to amend its Acts of 1903 and 1907 in order to borrow money for working capital for the electricity undertaking.

Royton.—The U.D.C. has decided not to object to electricity supply in the district by the Oldham T.C., if the latter body pays the cost of the requisite prov. order.

Sale.—On the recommendation of the resident electrical engineer, the U.D.C. has decided to apply to the B. of T. for sanction to the erection of overhead wires for the electric lighting of Northenden Road, along which it is proposed to construct a tramway. The estimated cost of the lighting scheme is £108.

Sheffield.—The general manager is to be empowered to increase the remuneration of the canvassers for the electricity department from £104 per annum to £130.

South Africa.—CAPE TOWN.—It is intended to have an Exhibition of Electric Lighting, Cooking, Heating, &c., in the City Hall about March or April, 1911, and applications are invited from electrical firms for space. Plans and all particulars may be obtained at the office of the Electrical Engineer, Dock Road, Cape Town, up to noon on January 31st, 1911.

SS. "Olympic."—This new White Star liner is to have four generating sets of 2,144 H.P. for the general supply of electricity to the ship. Some 6,300 lamps are to be installed, also 10 lifts, 60 radiators, 43 bathroom heaters, and an electrically-driven bakery; about 100 telephones are also to be provided. The complete installation will cost some £65,000. To aid in fitting out the ship, Messrs. Harland & Wolff are using a tug, which has been refitted as a floating generating station of 320 KW. capacity, and which supplies energy for lighting and power on board the liner.

Sunderland.—A report on new alternative tariffs in connection with general L.T. supply, which was to come before the Council on Wednesday last, provides for a supply to private houses for domestic purposes, where the premises are lighted throughout by electricity, 80 per cent. of the lighting being by metal filament lamps, on a fixed rental, plus ¾d. per unit metered. The fixed rental varies from 10 per cent. of the rateable value per annum for rateable values between £15 and £30 per annum, to 15 per cent. for a rateable value above £70 per annum. The percentage will be varied where the assessment is influenced by causes not affecting the use of electricity. The fixed charge is to be allocated as to one-sixth for each summer and one-third for each winter quarter. New rates are offered for offices, churches, shops, theatres, &c., and a rate of ¾d. per unit is provided where the premises are electrically lighted, for heating and cooking. For the L.T. power supply an alternative rate of £3 per annum per KW. of demand plus ½d. per unit is offered, with the proviso that the Corporation may supply either A.C. or D.C., and that it shall not be liable to give large intermittent supplies at this rate between 3.30 p.m. and 6.30 p.m., from November 1st to March 1st inclusive.

U.S.A.—A somewhat belated report of the electricity department of the City of Chicago for 1909, shows that the number of stations and lamps in the city under the jurisdiction of the department was as follows:—Companies' central stations 22, with 20,519 arc and 2,914,348 incandescent lamps; isolated plants 897, with 10,571 arc and 531,361 incandescent lamps; city street lighting stations 7, with 11,592 arc lamps; and city plants, isolated, 13, with 80 arc and 3,215 incandescent lamps. Some 5,231 electric signs were in use, and 159,244 H.P. of motors were supplied by the companies.

The Chicago Edison Co., for the year ending September, 1910, reported an equivalent of 5,915,622 16-C.P. lamps connected, exclusive of a large railway load. This company, in view of increasing business, has acquired 113 acres of land on the Chicago River, and is building a new station with an ultimate capacity of 360,000 H.P., of which 60,000 H.P. is expected to be in operation next autumn.

Walsall.—The Electricity Committee has decided to extend the H.T. mains for Messrs. Lambert Bros., Green Lane, to the proposed new sub-station at Bloxwich at an estimated cost of £1,150.

The same Committee reports that an explosion occurred in the Stirling boiler, by one of the tubes opposite the fire rupturing; one man was slightly scalded. The preliminary inquiry by the B. of T. into the cause of the explosion has been held. The whole front bank of tubes has been replaced at a cost of £120, which it has been arranged shall be equally divided between the Corporation and the insurance company.

West Ham.—In October last a letter was received from the L.G.B. in connection with an application for a prov. order to enable the Council to provide a working balance for electricity purposes, and stating that the Board would be prepared to entertain the proposal subject to an amendment of the Local Acts providing for audit of the whole of the accounts of the Council by the district auditor. The Finance Committee of the Council now reports that having considered a report by the borough treasurer dealing fully with the subject, it had decided, in view of the opinions expressed in the report of the Joint Select Committee of both Houses of Parliament on L.G.B. audit and the action taken by the Association of Municipal Corporations, both on this matter and on the question of overdrafts, that the application to the L.G.B. for a prov. order be allowed to lapse. In the meantime the B. of T. is to be asked to amend the Electric Lighting Order, which appears to have been improved upon for certain purposes in other districts, so as to admit of the use of any surplus (under certain conditions) for working capital. Some time ago experiments were carried out at Messrs. Goodacre & Sons' premises at Custom House with electric driving, and an arrangement has now been come to for driving all their machinery.

Westhampnett (Sussex).—The R.D.C. on Friday decided to defer its consent to the application of the Chichester E.L. Co. for a prov. order for E.L. in the Council's area, until a copy of the order has been deposited.

Wolverhampton.—The T.C. has obtained the sanction of the L.G.B. for a loan of £6,210 for the extension of the refuse destructor.

Worthing.—A Sub-committee of the Electricity Committee of the T.C. has been appointed to open negotiations with the various wiring contractors in the town as to the terms and conditions on which they will be willing to provide a showroom and fittings, and exhibit a scale of charges and other literature to be supplied by the Corporation.

Wrexham.—The T.C. has decided to allow two pupils to be received at the electrical works for a term of three years, the premium of £100 for each pupil, in advance, to be paid to the electrical engineer, Mr. Pickvance.

Yarmouth.—At a meeting of the T.C. on Tuesday the sanction of the L.G.B. was received to the raising of a loan of £5,800 to meet prospective expenditure on the electric light mains, a cooling tower and public lighting.

TRAMWAY and RAILWAY NOTES.

Accrington.—The Corporation is to meet the Rawtenstall and Haslingden Corporations to settle a definite fixed payment respecting the difference in consumption of electrical energy by the cars of Rawtenstall and Accrington, and the equitable division of such payment as between Haslingden and Accrington.

Birkenhead.—With the object of securing economy in the use of energy for traction, meters have been installed in six of the Corporation tramcars, and the Tramways Committee recommends that 50 more cars be fitted with meters.

Burnley.—The T.C. is to discuss a suggestion by the Colne and Trawden Light Railway Co. for the consolidation of tramways in the locality, or a through-running service from Colne to Padiham.

Continental Notes.—FRANCE.—The Dunkirk and Calais Tramways Co. are in negotiation for the purchase of the tramway at Saint Pol-sur-Mer, with the view of converting it to electric traction.

GERMANY.—The formation of a huge trust company for the electrification of the South Germany railways is now on the boards. The new concern will bear the title of the Oberrheinische Eisenbahngesellschaft A.-G., and have its headquarters at Mannheim. The objects of the company are stated to be the building, acquisition and working of railways. Its founders comprise the city of Mannheim, the South German Railway Co. (of Darmstadt), the Neue Rheinau Co., the Rheinische Schuckert Gesellschaft für Elektrische Industrie A.-G., and the Suddeutsche Diskontogesellschaft A.-G. (Mannheim). The trust will take over the so-called South German "railway triangle," the Mannheim-Heidelberg-Weissheim-Mannheim line, the suburban Käfertal-Heddesheim railway, the concessions for the Mannheim-Schriesheim and the Schwetzinger-Ketsch lines, as well as the generating stations at Rheinau and Ladenburg. The capital of the new company will amount to 8,000,000 marks, of which the city of Mannheim will take 51 per cent., the other founders together 49 per cent. In addition, it is intended to issue bonds to the extent of 18,000,000 marks. —*Zeit. f. d. ges. Turbinenwesen.*

Darwen.—The T.C. has decided that meters shall be provided on all electric tramcars on the local service.

Denton.—The U.D.C. intends leasing until June 1st, 1923, the tramways in the town to the Manchester T.C.

Doncaster.—The T.C. has decided to abandon the projected extension of the tramways to Bentley "owing to the unreasonable demands" of the R.D.C. The latter body was asked to contribute towards the cost of £380, the estimated cost of road works, but only offered to contribute £100.

Glasgow.—The Tramways Committee has been giving consideration for some time to the question of transfer tickets, coupon tickets, children's fares and other proposals. The complete proposals of the Committee are:—

That it is inexpedient to make any experiment with transfer tickets.

That two-stage coupon tickets be tried for a period of four months. These tickets will be of the face value of ¾d. each, and will be sold in quantities at the rate of six for 4½d. or 12 for 9d. The conductor will accept one of the special coupon tickets for any two consecutive ½d. stages, and will give in exchange therefo a ¾d. ticket.

That, in view of the second recommendation, no action be taken in connection with the remits as to the extension of ½d stages.

That, with a view to a uniform practice being observed with regard to all children, the age up to which children may travel on the cars for half fare be raised from 12 to 15 years.

In his report on the suggestions, Mr. Dalrymple, the manager, states, in connection with the adoption of a coupon system to give two of the present ½d. stages for ¾d., that they would require to sell these coupons at the rate of 12 for 9d., which would mean a reduction of 25 per cent. The conductor would accept these coupons as cash and issue a ticket which would carry a passenger over two consecutive ½d. stages. He was of opinion that if anything in the nature of reduced fares was given, it should be granted in such a way that the whole body of the citizens should have full advantage, while the conductors at present had enough to do in collecting the ordinary fares. He did not see any difficulty in carrying out such a scheme if the citizens of Glasgow were prepared to cope with the tremendous flood of farthings which such a system would bring into the city, and if the Corporation was prepared to face a drop in tramway revenue, which would not be less than £70,000 per annum. Regarding the suggestion for a three-quarter mile stage for ½d., the manager pointed out that, based on last year's figures, this would represent a reduction in the revenue of £31,261. In fact, last year's surplus of £56,418 might easily be converted into a loss. With reference to the raising of the children's age limit for half fare, the manager considered that so long as the department carried out the regulations in a liberal spirit there should be no call for any change.

The general manager has been instructed by the Committee on Works (subject to the approval of the T.C.) to proceed with a junction of the southern district car lines at Elgin Street, in order to link up Eglinton Street and Pollokshaws Road.

The Corporation's Committee on Watching and Lighting has submitted for consideration a proposal that a contribution be made by the tramways department towards the increased cost of lighting certain streets of the city, as a result of tramways traversing those streets.

Droylsden.—The U.D.C. has decided, subject to the consent of the B. of T., to lease the tramways in the town to the Manchester T.C. for 21 years.

Little Hulton.—The U.D.C. has informed the county surveyor that it is prepared to bear the cost of acquiring the necessary land and buildings for widening Manchester Road West, in connection with the tramways proposed by the South Lancashire Tramways Co.

London.—HAMMERSMITH.—No objection is to be raised by the Borough Council to a proposal for the construction of additional junction lines between the L.C.C. tramways in Queen Street, Hammersmith, and the London United Tramways in Beadon Road and King Street. It was mentioned in a letter from the L.C.C. that negotiations are at present proceeding with the London United Tramways for the purchase of the portion in London of the company's undertaking, and the new junctions will not be constructed until after the purchase is completed. Last month the B.C. wrote to the B. of T. renewing the application for the nomination of a referee to determine the difference which has arisen between the Council and the London United Tramways (1901), Ltd., with regard to the condition of the tramway tracks. The Board has now written to the Council enclosing a copy of a communication received from the company, intimating its intention to keep the tramway tracks in a proper state of repair. The town clerk was directed to reply to the B. of T., pointing out that during the last three years notices had been served from time to time upon the company, in which the specific requirements of the Council with regard to the repair of the tramway tracks had been set out; that the tracks and rails are in a defective and dangerous condition generally, and that the only effective and satisfactory way of dealing therewith is to reconstruct and relay the paving throughout the whole length of the tracks in respect to which representations had been made by the Council.

Nelson.—On December 8th, the Burnley T.C. gave a month's notice to discontinue Nelson's supply of electricity for tramway purposes in Brierfield, the latter town and Burnley having arrived at an understanding.

Newcastle-on-Tyne.—At a meeting of the City Council on the 12th inst., further consideration was given to the Corporation Parliamentary Bill, which is to be introduced this session. A number of clauses refer to tramways, and Mr. Rodgers, in moving that the Bill be deposited in Parliament, stated that the cost of the tramways was estimated at £61,000, and equipment (including railless trolley cars) at £27,551. The first portion of the Bill was to enable the Corporation to construct new tramways, certain sections in the city, and one extension to Newburn-on-Tyne. Objection was raised to the extension to Newburn-on-Tyne, and also to the laying of the proposed lines in Shieldfield, within the city. Mr. Rodgers explained that the cost of putting down the tracks in Newburn would be £38,600, and for the overhead equipment £5,886. As to the railless cars, the proposal was to run from the end of Fenham Road Drive to Westerhope, beyond the boundary. They were also asked to link up the Scotswood Road service of trams with Blaydon on the south side of the river, by trackless vehicles. He mentioned that they had rails in stock for the Newburn extensions. After discussion, the resolutions as to the tramways were carried.

New Zealand.—Tramway men in the Dominion are proposing a revised scale of wages, which it is desired to have registered as an award of the Arbitration Court, and in the scheme provision is also made for preference to unionists, a condition of employment being that the employés shall become and remain members of the union. An eight-hour minimum day is also asked for. It is proposed that the minimum pay of motor men shall be from 1s. 1½d. per hour to 1s. 3d. per hour, according to length of service, and of conductors, 1s. per hour to 1s. 1½d. for an eight-hour day. Requests are made for a scale of holidays on full pay, ranging from eight to 16 consecutive days per annum.

Scarborough.—The difficulties of the Scarborough Tramways Co., and their effect upon the Corporation and the town, again formed the subject of discussion at a meeting of the T.C. on Monday night. The chairman of the Streets and Buildings Committee, after remarking that the B. of T. had given as its award that the company should run a winter service of cars, said that, in response to a letter from the company, the Committee had said the Corporation could not be responsible for any loss caused by the running of a winter service, but it was prepared to meet the directors and discuss matters. Councillor Moore said it was reported in the town that the Tramways Co. owed the Corporation £4,000 to £5,000; the fact was that rather less than £105 was owing, and it had been contracted within the last two months. The company's rates were fully paid up to next March. The Corporation had no cause of complaint whatever as to the conduct of the company towards it as traders. The award of the B. of T. fully justified the Corporation in insisting on a winter service. A conference between representatives of the Corporation and of the company is being arranged.

Meanwhile the town clerk has been instructed to delay taking any proceedings against the Tramway Co. for penalties for suspending the service until further instructed, and the borough engineer has been instructed to carry out such repairs between and alongside the tramway tracks as are absolutely necessary.

The company has written to the B. of T. stating that in view of the Board's recent order, the only possibility of continuing the tramways in Scarborough is either the suspension of the winter service altogether, or an arrangement by which the Corporation would relieve the company of the loss entailed by such winter service.

Sheffield.—An offer by Messrs. Siemens Bros. Dynamo Works, Ltd., to supply a pair of traction motors and controllers for a six months' trial on one of the Sheffield cars free of cost, has been accepted by the tramways department.

Torrington-Halwill.—It is proposed that the Devon C.C. shall approve of the construction of a light railway between Torrington and Halwill, *viâ* Hatherleigh, and shall advance a sum not exceeding £15,000 towards the cost.

Yarmouth.—At a recent meeting of the T.C. it was decided to equip all the electric cars with current meters at a cost of £113 15s.

TELEGRAPH and TELEPHONE NOTES.

Wireless Telegraphy.—According to the *Liverpool Journal of Commerce*, the Colonial Sugar Co. is about to establish a system of wireless telegraphy at its mills in the Fiji Islands. The mills are situated on different islands, and some of them are hundreds of miles apart. Their steamer *Fiona* is also to be fitted with wireless apparatus. When the installations are completed at all the mills communication will be maintained between all the company's properties, and will enable the *Fiona* to be advised by wireless at which island she is required to call.

Russia.—One of the troubles of telephone companies in Russia is the practice, very prevalent among a certain section of the public, of stealing the copper wire of the lines. It is stated that the line between St. Petersburg and Moscow is rendered idle for hours several times a week from this cause.

London.—The Post Office authorities are converting a large block of buildings in St. James's Square, E.C., into a new telephone exchange.

A Poplar Conversazione.—The conversazione and social evening in connection with the Association of Electrical Engineering Students, L.C.C. School of Engineering and Navigation, Poplar, E., took place at the School on Saturday, December 3rd, a very interesting programme being arranged. Members and their friends were received by the President of the Association, Mr. H. A. Garratt. During the evening a concert was given, and four interesting lecturettes were delivered on various topical subjects: "Colour and Electric Light," by Mr. J. Paley Yorke; "Fireworks," by Mr. B. J. Field; "Frozen Mutton and other Edibles," by Mr. J. H. Robsen; "Iron from Mine to Foundry," by Mr. D. Gordon. Exhibitions and demonstrations were given in all the laboratories and workshops. The next meeting of the Association has been arranged for to-morrow, Saturday, December 17th, at 3.30 p.m., when a paper on "Electric Waves" will be read by Mr. E. A. Martin. All past and present members of the school are invited to join the Association. Information can be obtained at the School, or of the hon. secretary, Mr. W. T. Brading, 26, High Street, Deptford, S.E.

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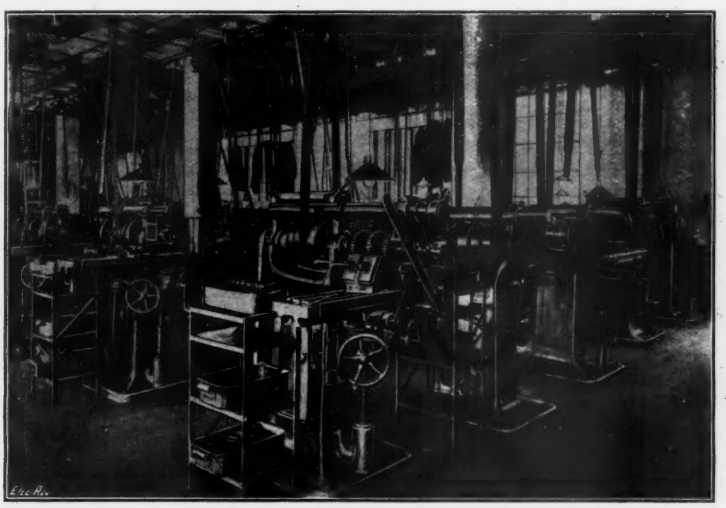
THE TELEPHONE WORKS OF THE WESTERN ELECTRIC CO., LTD., WOOLWICH.

Some years ago—in March, 1905—we published an illustrated description of the Cable Works of the Western Electric Co.; at that time the apparatus factory was in building, but was not yet equipped and organised. Now, however, it is in full swing, and as it is one of the most important works in this country for the manufacture of telephone exchange equipment and telephone apparatus in general, we give herewith a number of illustrations and particulars regarding the plant and methods of organisation employed.



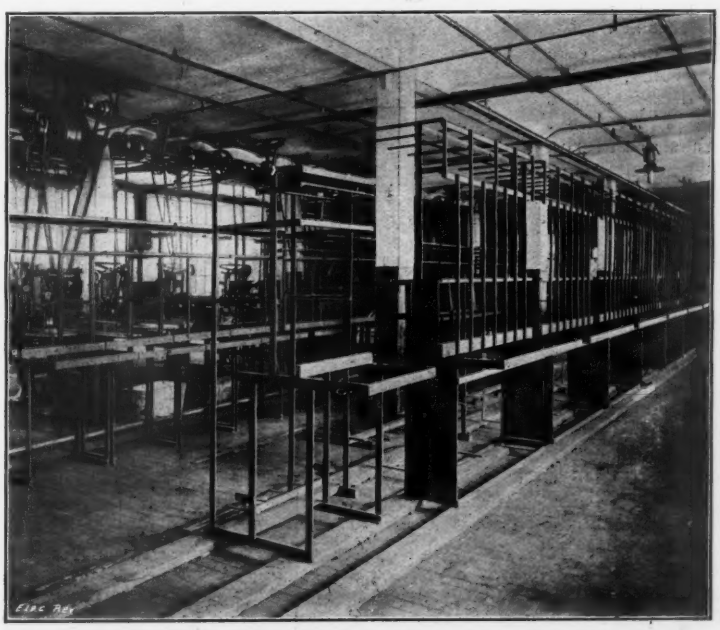
Milling Machines.

The apparatus factory is situated near the middle of the site, over 6¼ acres in area, occupied by the company's works and offices on the north bank of the Thames at Woolwich; it consists in the main of three blocks of four storeys, together with several minor buildings of one and two storeys, intercommunicating or closely adjoining. The total floor area occupied by the switchboard and instrument manufacturing, assembly, finishing and testing departments is over 1½ acres; the shipping departments and stores cover one acre, and the cable works over 1½ acres, the total covered floor area including the general offices, &c., being 5¼ acres.

Power and light are supplied from the company's own generating station, electric driving being, of course, employed throughout. Various systems of lighting are in use, depending upon the requirements in each case; generally, enclosed arc lamps and carbon incandescent lamps are employed, but experiments are being made with a view to overcoming the difficulties incidental to the use of metallic-filament lamps due to vibration, &c. The fire-prevention arrangements are very complete, Grinnell sprinklers being installed throughout; fire-buckets and extincteurs are also provided at various points, and there is a staff fire-brigade, drilled at regular intervals by the factory engineer. The departments are divided from one another by double iron doors.

The works are admirably situated for transport, having a riverside wharf at one end of the site, and adjoining the Great Eastern Railway at the other end. Raw material for cable manufacture and for the apparatus factory is received at the wharf and passed through the inspection department to the stores. The inspection department is a very important feature of the works' organisation, being met with at every turn, and it may be well to explain at this point that it is entirely independent of all other departments, and that its operations are highly systematised. A copy of every order for material is furnished to the inspection department, with the corresponding specifications, and is placed on file in the appropriate receiving office pending the arrival of the goods, which immediately on receipt are examined in detail and compared with the specification and order, chemical analyses and physical tests being duly made, where necessary, before the materials are accepted. The department steps in, as we shall see, at every stage to check the quality of the work, until the finished product has been duly passed and shipped or put in store, and its only concern is to see that no defect of material or workmanship shall escape notice at any stage of the operations.

Adjoining the store on the ground floor is the milling department, equipped with a large number of milling machines of various types, for the machining of parts of brass, ebonite, &c.; these are driven by belt from countershafting overhead, the power being



Switchboard Frames in Course of Erection.

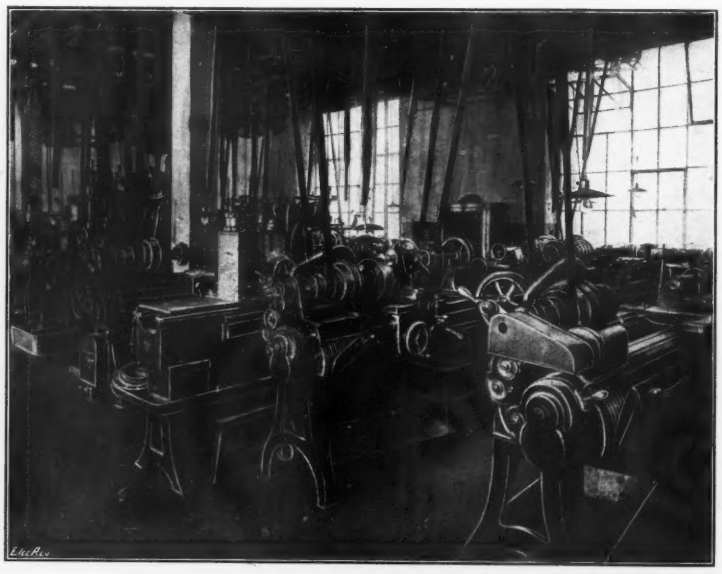
Punch Press Department.

derived from inverted motors bolted to the ceiling. Adjoining these are six engraving machines, driven by individual motors; the work done on these is filled in and the parts are inspected close by, after which they go to the stores. At the further end of this room is the punch-press department, which is equipped with presses of all kinds, from very small ones operated by treadle, for mica and other light work, code numbering, &c., up to heavy Rhodes presses for sheet brass and iron punching and stamping, belt-driven from overhead shafting. Quite a large variety of operations is carried on here, including some of the heaviest work required in telephone manufacture. All material operated upon has to pass the process inspector before leaving the department.

Next we come to the one-storey building round which the three main blocks are arranged; in this is the "partial assembly" department, where various intermediate operations are carried on, and here also is the fitter's shop, equipped with a number of lathes, drills, grinders, and other tools for general work, including repairs to motors, &c. This repair department is under the charge of the factory engineer, who is responsible for the maintenance and repair of all the machines in the works.

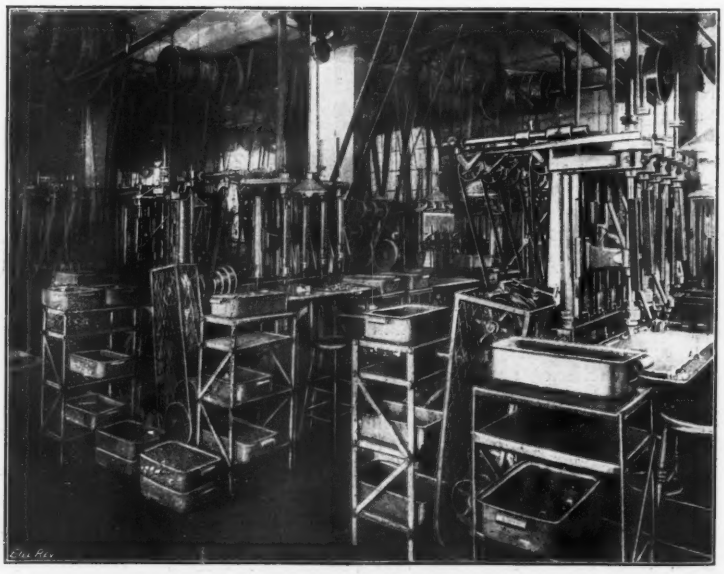
Re-entering the main building, on the ground floor, we next come to the iron-working department, where the parts of the steel frames of exchange and other switchboards are prepared. The tinsmiths' shop occupies a portion of this floor. Overhead is the switchboard frame assembly department, where, at the time of our visit recently, a long switchboard was in course of erection for the British Post Office, besides numerous smaller frames for various authorities. Every switchboard is erected complete—without, of course, connecting the cables—in the workshops, and dismantled for shipping to its destination, except in the case of private exchange boards, which are shipped wired complete. A variety of tools required in this department is provided—many vertical drills, shears, emery wheels, milling machines, &c., for use in fitting and assembling the parts. Large power boards and heavy slate fuse panels are also fitted and erected here, special vertical drills being employed for drilling the slate.

On the same floor, in the next block, is the tool-making room—a very important department. Here there is an exceptionally fine equipment of turning, shaping, grinding and milling machines, and gas-heated furnaces with electrical pyrometers for tempering the tools. A small drawing office for designing tools is provided in this department, and a tool inspection office, through which all tools must pass on the way to the tool store at the end of the room.



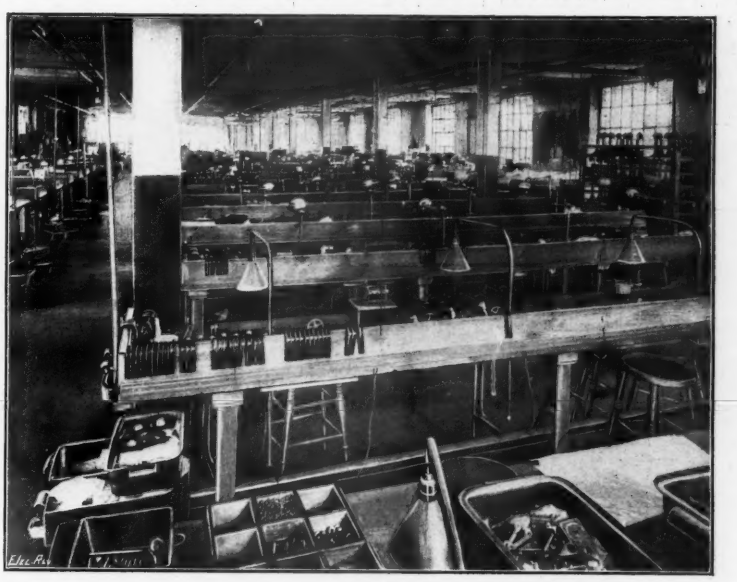
Tool-Making Room.

A large room on this floor, in the next block, is devoted to drill-press and screw machinery; the drill-presses of various types, for single and multiple drilling, are operated by girls, the drills being set by mechanics. Alongside these are



Drill Press Department.

a number of semi-automatic tapping machines for small work, with individual drive—the drill-presses are group-driven from the ceiling. Beyond the drilling machinery is a large collection of full-automatic machinery for making small parts such as screws, as well as many semi-automatics, turret lathes, &c., for large work—about 60 in all, if we recollect aright. The work turned out by some of these machines is really beautiful, the highest accuracy being aimed at, and indeed essential to the attainment of the best results. We may mention that the limit-gauge system is, of course, in force in these works, and the limits are set very close.



General Assembly.

On the next floor is the large wood polishing and mounting department, which includes a section specially partitioned off to exclude dust, where the finest effects are obtained; steam heating is adopted for quick drying. Next to this is the subscribers' set assembly department, and store for finished piece parts; and beyond this again is the general assembly room, where the various components of the instruments are finally brought together and connected up. This is a very important department, and at this stage the inspectors' scrutiny is exceptionally keen and critical. Transmitters are subjected to exacting tests, undergoing, so to speak, an oral, or aural, examination—which should it be?—; the speaking is tested against a standard transmitter, which is in turn checked every day, and the insulation is proved by the application of 500 volts A.C.—a pressure which is applied to all the electrical apparatus. The microphones made in the works are of the Solid-back type.

Service meters, provided with a patent attachment which renders over-running impossible, are run up to 10,000 revolutions and tested for operating current before despatch. Line and cut-off relays are tested for spring pressure with limit gauges, and for operating current, and jack strips are minutely examined. Subscribers' table-sets are tested with maximum and minimum weights on the hook; these sets, by the way, are being made in an entirely new and much-improved pattern, and the hooks, detachable for convenience in packing, cannot be removed after springing into place without opening the case.

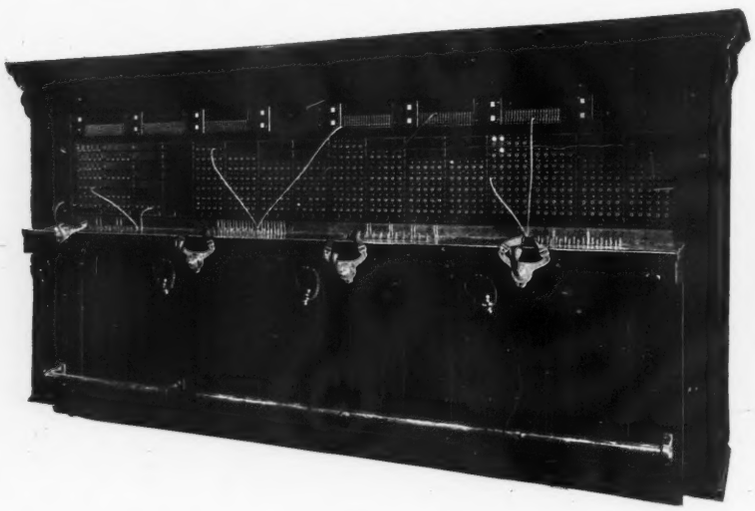
Screw-Making Machinery.

Switchboard Assembly Department.

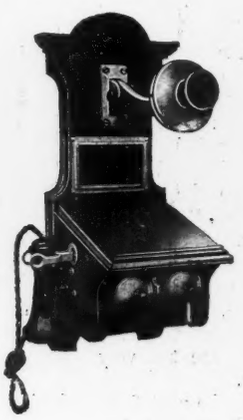
Condenser Department.

Coil-Winding Room.

Magneto generators are run at a constant speed, and tested with a high-class voltmeter. In this department the power station is situated, which supplies current to the whole of the works for testing purposes. It includes three 12-cell storage batteries, and motor-generators supplying ringing current, and 500-volt alternating current for testing, the initial supply being derived from the works' power station. All the apparatus is tested when fitted up, quite independently of the check tests afterwards applied by the inspection department.



Series Multiple Magneto Switchboard for Federated Malay States.



C.B. Wall Telephone Set.

On the third floor, above the department last described, is the switchboard-erecting shop, where the apparatus composing the switchboard equipment is fitted into place, and where the extremely interesting and apparently highly complicated process of building up cables for multiple switchboard sections and private exchanges and wiring them up is carried on. The cables are laid out over pins on boards, somewhat after the manner of a railway traffic chart, and are bound up complete, ready to be fitted into their places in the frames and connected up. These, of course, are for connecting the keys with the plugs, cords and other apparatus on the sections; the cables for connecting the multiple jacks of the large switchboards and connecting them with the main frame, lightning arresters, &c., are prepared in the top room in the opposite wing.

On the way to the latter we pass through the coil winding room, where girls are engaged in winding and testing coils for relays, &c., and armatures for magnetos. Simple little Wheatstone bridges are provided, one to each two girls, with which they can measure the resistance of the coil by comparison with one which is correctly wound. The coil winders are driven by motors under the benches. In the coil-winding room also loading coils for telephone cables are wound, the Western Electric Co., Ltd., being the owners of the patents covering these in this country. Special machines are provided for winding the toroidal cores of soft-iron wire, the insulated copper wire wound on a shuttle being carried through the interior of the ring by mechanical means. A test-room for very accurate measurements on loading coils is provided in this room, and is equipped with suitable apparatus, including a high-frequency alternator and a Campbell "sieve."

The remaining room in the apparatus works, as previously indicated, is devoted mainly to the preparation of cables for wiring long exchange switchboards; this apparently most complex operation is reduced to a matter of line and rule, so that the operators have merely to follow a set pattern, though a superficial observer may well stand appalled at the seeming confusion of wires. But the women employed in this work know their business, and reduce chaos to order with an uncanny certainty and nonchalance. At the end of this room is a department for the winding of condensers on the Mansbridge system, which we have already fully described.

The condenser department is equipped with vacuum apparatus for impregnating the condensers with paraffin, and hand-presses for squeezing out the surplus wax; and electrical testing apparatus is provided for measuring the capacity of the condensers, which is adjusted before they leave the department.

C.B. Table Telephone Set

Switchboard Cabling Department.

This completes our circuit of the main buildings. In an adjoining two-storey building there is, on the ground floor, a general jobbing machine shop for special work, not provided for elsewhere, and an experimental model-making department, well equipped with a variety of machine tools; adjoining the latter, and working in conjunction with it, there is an electrical test room and laboratory. On the floor above is the carpenters' shop, where the woodwork of the switchboard frames is made, and all necessary cabinet work is done.

A long building of one storey, adjoining the main factory, is set apart for dipping, nickel-plating, metal polishing, japanning and lacquering, each operation being carried on in a separate room. The latest methods are here in vogue, and the equipment is very complete and efficient, the finish of the completed articles being of the highest excellence.

Even now, when we have reached the end of the manufacturing operations and have arrived at the point where the finished apparatus go into the stores ready for shipping, we cannot escape the watchful eye of the engineering inspection department; every consignment is subjected to a final "super-inspection," before leaving the works. Only by such rigorous and repeated examination is it possible to ensure that every instrument and appliance shall be absolutely free from defect in construction or operation—and when the extreme intricacy and delicacy of the mechanism and wiring of a telephone exchange is borne in mind, together with the multiplicity of connections (there are nearly half-a-million jacks, and over four million soldered joints, in the Central Exchange of the Post Office, equipped by the Western Electric Co.), it will be recognised that unless errors and defects are reduced to a negligible quantity, disaster is certain to ensue.

A reference to the medical department should not be omitted; here a skilled attendant is always on duty, ready to give "first aid" to any employé who may meet with an accident—and his services are frequently in requisition, in spite of the adoption of the safeguards to machinery required by the Home Office Regulations.

We give herewith a number of views of the interior of the works, and some typical illustrations of the company's products. The multiple magneto switchboard shown is of special interest on account of the use of the new combined signal and jack; the signal, which takes the place of the lamp used on C.B. systems, is called the "eye-ball" type, consisting of a light metallic red segment of a sphere, which comes into view at a window and presents a very conspicuous appearance. The jack is situated immediately below the signal, and the latter is automatically restored on the insertion of the plug.

Not the least important feature of the company's methods is the highly developed system on which the staff is organised. The work is divided up into departments, the heads of which are responsible directly to the managing director, Mr. Pingree; each department is again divided and sub-divided repeatedly, and the whole is so arranged that the responsibility for every operation is clearly defined and localised through a chain of officials. Care is taken to prevent loss of efficiency through a too-rigid adherence to formality, and free communication takes place between officials in corresponding positions in different departments, so that there is no delay; but important matters are all referred through the proper channels to the managing director, and after his decision are passed on automatically to their proper destinations, without friction or confusion.

In concluding this brief review of the company's telephone apparatus works, we wish to record our appreciation of the courtesy and ready assistance of every one of the staff with whom we have come in contact, and our thanks to the directors for facilities to photograph the works and to obtain particulars of the equipment.

S.P. Surface-Contact System.—We are informed that the American Surface Contact Co. has been incorporated in New York with a capital of $250,000 to acquire the American and Canadian rights of the S.P. (Surface-Contact System) Syndicate, Ltd., 88, Fenchurch Street, E.C.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.— December 21st. Concentric lead-covered, single-conductor lead-covered, and three-core lead-covered cables, for the Melbourne City Council. See "Official Notices" Dec. 9th.

December 29th.—(*a*) Telephone cable, (*b*) battery and line material and instruments, for the P.M.G.'s Department in South Australia. See two "Official Notices" November 4th.

January 4th, 1911.—Three multiple switchboards, for the P.M.G.'s Department in New South Wales. See "Official Notices" November 4th.

January 4th, 1911.—Iron poles, ironwork, and switchboards, for the P.M.G.'s Department in Queensland. See "Official Notices" November 18th.

January 10th, 1911.—Telephone cable, for the P.M.G.'s Department in Victoria. See "Official Notices" November 18th.

January 10th, 1911.—Contacts and condensers, for the P.M.G.'s Department in Victoria. See "Official Notices" November 18th.

January 24th, 1911.—Wire, twisted pair, for the P.M.G.'s Department in Victoria. See "Official Notices" December 2nd.

January 25th, 1911.—Portable petrol-driven winch, for the P.M.G.'s Department in New South Wales. See "Official Notices" December 2nd.

January 25th, 1911.—Insulators, wire, &c., for the P.M.G.'s Department in South Australia. See "Official Notices" Dec. 2nd.

January 30th.—The *Australian Mining Standard* states that the New South Wales State Railways Department is inviting tenders for two electrically operated elevators at the tramway repair shops, Randwick.

The same exchange states that the date (November 28th) for sending in tenders to the New South Wales Public Works Department for hydro-electric generator, transmission line, and pumping machinery, for water supply of towns north of Wollongong, has been extended to January 16th.

February 1st, 1911.—Testing equipment, for the P.M.G.'s Department in New South Wales. See "Official Notices" December 9th.

February 7th, 1911.—250 indicators, for the P.M.G.'s Department in Victoria. See "Official Notices" to-day.

March 7th, 1911.—Eleven sections of a branching multiple magneto lamp-signalling switchboard, for the P.M.G.'s Department in Victoria. See "Official Notices" to-day.

Melbourne.—February 22nd, 1911. 2,000 steel tramway plates. Specification, conditions, &c., at the City Surveyor's office, Town Hall.

Perth.—April 18th, 1911. According to the *Australian Mining Standard*, tenders are invited for one common-battery switchboard for the Perth Central Exchange, consisting of two junction, seven subscribers', four end, two cable-turning and two cable-storing sections, together with all necessary frame racks, power plant, and associated apparatus, as per Specification No. 353 and Schedule No. 85. Specifications, &c., at the office of the High Commissioner, London.

Sydney.—January 23rd. Two 750-kw. units for Newtown substation for the Government Railways. Particulars at Electrical Engineer's Office, 61, Hunter Street, Sydney, N.S.W.

Western Australia.—February 28th. Electrical pumping machinery for the Minister of Public Works. Conditions, &c. (one guinea) from the Contractors' Room, Public Works Office, Perth.

Barking.—December 20th. 400-kw. Diesel engine and dynamo, 250-kw. motor-generator, traction battery and reversible booster, main switchboard and connections, and overhead travelling crane, for the U.D.C. Specification from Mr. Henley L. Howard, engineer (deposit two guineas).

Belgium.—January 4th. The Belgian Post and Telegraph authorities at La Bouse, Brussels, are inviting tenders for the supply and fixing of a large quantity of telephone cables in the Liége district.

Canada.—December 22nd. Calgary (Alberta) City Commissioners want tenders for a 1,500-h.p. synchronous motor-generator, motor-generator exciter set, switchboard, &c. Specification to be seen at the C.I. Branch of the Board of Trade in London.

Dundee.—The Corporation (Electricity Department) invites tenders for cables.

East Ham.—December 30th. One 1,000-kw. triple-expansion medium-speed steam engine and generator, and one evaporative condenser, with air and circulating pumps, piping, &c., for the Corporation. See "Official Notices" December 9th.

Germany.—The municipal authorities of Baselstadt are about to invite tenders for the extension of the electric lighting undertaking, at an estimated cost of £30,000.

Keighley.—About 4,000 tons of steam coal, pea slack or rough small, for the Corporation Electricity Department; Borough Electrical Engineer.

Leytonstone.—December 30th. Electric lighting installation at the new County High School, Forest Road, for the Essex Education Committee. See "Official Notices" December 9th.

Llandudno.—December 24th. (*a*) Motor-driven induced-draught plant, (*b*) mechanical stokers for one Lancashire and one Babcock boiler, for the U.D.C. See "Official Notices" Dec. 9th.

London. — Islington.—January 12th, 1911. High-tension switchboard for the Borough Council Electricity Works. See "Official Notices" November 25th.

January 10th, 1911.—High and low-tension switchgear. See "Official Notices" December 9th.

Hackney.—January 4th. Installations of telephones in Pavilions A and B, at the Infirmary, High Street, Homerton, and removal of existing installation in Pavilion A, for the B. of G. See "Official Notices" to-day.

Manchester.—January 9th. The Tramways Committee invites tenders for special (permanent way) trackwork. Specifications and tender forms from J. M. McElroy, general manager of Corporation tramways, 55, Piccadilly, Manchester; deposit £2 2s.

New Zealand. — Taihape. — January 11th. Hydro-electric lighting and pumping plant for the B.C. Specification can be seen at C.I. Department of the Board of Trade in London.

Salford.—January 16th. Steam-driven air-lift pumping plant, for the Corporation electricity works. See "Official Notices" to-day.

Shanghai.—January 4th, 1911. Two turbo-alternators, 2,000 to 2,500 kw., with condensing plant, and four water-tube boilers, with integral superheaters, mechanical stokers, economisers, &c., for the Municipal Council. See "Official Notices" Dec. 9th.

Sheffield.—December 30th. Building work for extension to Neepsend power station, for the Corporation. See "Official Notices" to-day.

Spain.—The municipal authorities of Eiche (province of Alicante) have just invited tenders for the concession for the electric lighting of the town during a period of four years.

CLOSED.

Accrington.—At the T.C. meeting last week it was stated that the lowest tender for ironwork for extensions to the electricity works was from Messrs. J. W. Bridge.

Australia.—The *Australian Mining Standard* states that the following tenders have lately been placed :—

Victoria.—Postmaster-General's Department.—J. Bartram & Son (Melbourne).—3,200 telephones, wall sets, magneto, complete, at 52s. each, £8,320; 200 telephones, bridging table, consisting of generator, magneto bell micro-telephone, and distributing block, containing lightning arrester and terminals, 58s. 6d. each, £585; 100 telephones, table sets, at 58s. 6d. each, £292 10s.

Western Electric Co. (Australia), Ltd., Sydney.—100 telephones, common battery, wall pattern, at £2 16s. 3d. each, £281; 10 telephones, do., table pattern, at £2 14s. 6d. each, £27; 3,000 telephone protectors, at 2s. each, £300; 3,000 condensers, 2 mfd., in case 4⅜ in. × 1¾ in. × 1¾ in., with connecting lugs, at 2s. each, £300.

British Insulated and Helsby Cables, Ltd., Melbourne.—100 switches, common battery, single extension and inter-communication, at £1 5s. each, £125; 100 telephone table sets, at £1 18s. each, £330.

India-Rubber and Gutta-Percha Telegraph Works Co., Ltd., Melbourne.—1,000 coppers, with insulated connecting wire, for gravity cells, at 6½d. each, £27; 10,000 zincs, for gravity cells, star form, at 11¾d. each, £474; 10,000 zincs, Leclanché, at 1¾d. each, £75; 6,000 zincs, Meidinger, main, at 6¾d. each, £166.

A. J. Chamberlain & Co., Melbourne.—3,000 oil insulators and 2,500 spindles, £230.

Belgium.—Six firms submitted tenders to the Société Nationale des Chemins de Fer Vicinaux, of Brussels, for the supply and erection of the overhead equipment required in connection with the light electric railways in the Lorrain district, the lowest being that of Messrs. Selliez, of St. Ghislaix, who quoted 45,434 francs.

Blackburn.—Mr. R. Baron, of Fleetwood, has received the contract for a power and lighting installation at the new works at Wyre Dock of the Fylde Ice and Cold Storage Co.

The Electrical Committee has accepted the tender of the Howe Electrical Co., of Blackburn, for the electric light installation at the new schools in Bangor Street.

Brighton.—Messrs. Siemens Bros. Dynamo Works, Ltd., of Dalston, have obtained the annual contract for 50-c.p. "Onewatt" lamps for street lighting.

Bristol.—The T.C. has accepted the tender of Messrs. F. & W. Bracher, of Bristol, for lighting and heating the electrical offices, showrooms, &c., at £102 10s.

Dartford.—The U.D.C. has accepted the tender of Messrs. Goldsmith for 1,190 tons of Rubbly Culm coal, at 12s. 4d. per ton.

Germany.—The Bergmann Electricitäts Unternehmung Gesellschaft, of Berlin, has secured a contract from the municipal authorities of Mayen (Eiffel) for the construction of an electric railway to serve the whole of the mining district in the neighbourhood of that town.

Glasgow.—The T.C.'s Committee on Works and Stores recommends the acceptance of the following tenders :—

Rubber cables.—Liverpool Electric Cable Co., Ltd.; W. T. Glover and Co., Ltd.
Rails.—Bolckow, Vaughan & Co., Ltd.

The offer of Messrs. John Broadfoot and Son, Ltd., for covering six car floors and steps with tackoid has been accepted by the Committee. A division took place on the offers for the supply of copper rail-bonds. The United States Steel Products Co.'s offer was the lowest, but an amendment, carried by the casting vote of the chairman, favoured placing the order with the British Insulated and Helsby Cables, the lowest home tenderer.

London.—Stepney.—The Electricity Committee accepted the tender of Messrs. Bradbury, Son & Co. for 450 tons of coal, at 13s. per ton.

L.C.C.—The Highways Committee received tenders as follows for (1) 5,000 tons of track rails and fastenings, (2) for about 700 tons of conductor rails, required in connection with the construction or reconstruction of further lines in the 1910-11 programme, and for maintenance purposes :—

(1) *Track rails and fastenings :—*

John Batt & Co. (London), Ltd.	£32,045
Walter Scott, Ltd. (recommended)	32,855
Bolckow, Vaughan & Co., Ltd.	36,000
P. & W. Maclellan, Ltd.	37,325
Barrow Hæmatite Steel Co., Ltd.	37,450
The North-Eastern Steel Co., Ltd.	38,150
Dick, Kerr & Co., Ltd.	40,035
Cammell, Laird & Co., Ltd.	Incomplete tender.

Chief engineer's estimate, £35,650.

(2) *Conductor rails.—*

Frodingham Iron and Steel Co., Ltd. (recommended)	£6,914
Walter Scott, Ltd.	7,047
P. & W. Maclellan, Ltd.	7,202
The North-Eastern Steel Co., Ltd.	7,325
Steel, Peach & Tozer, Ltd.	7,587

Chief engineer's estimate, £7,089.

"As regards the track rails and fastenings, the lowest tender received is that of John Batt & Co. (London), Ltd., who propose to supply rails manufactured in Belgium by the Belgian Steel Rail Syndicate. We would point out that the difficulties of inspection during manufacture are greatly increased when the rails are made abroad, and the same control cannot be exercised over the work. Moreover, considerable extra cost has to be incurred in inspection when the work extends over a long period. Certain of the rails included in the proposed contract are urgently required in connection with tramway works now in hand, and it is very desirable that they should be obtained with the least possible delay. In the circumstances, we are of opinion that the second lowest offer, that of Walter Scott, Ltd., amounting to £32,855, which is only £810, or 2½ per cent. higher than the lowest tender, should be accepted."

The following tenders were received for the overhead electrical equipment required for the construction of the Putney Bridge to High Street, Wandsworth, tramway :—

Clough, Smith & Co., Ltd. (recommended)	£2,016
British Insulated and Helsby Cables, Ltd.	2,222
Dick, Kerr & Co., Ltd.	2,258

Estimate of chief officer, £2,300.

With reference to the reconstruction of tramways from Baring Street to Finsbury Park, it is proposed that the cables (£3,800) be obtained from W. T. Henley's Telegraph Works Co., Ltd.; one motor-generator (£1,750) from Dick, Kerr & Co., Ltd.; and that the duct-laying (£3,500) be placed with Reid Bros. Engineers, Ltd.

The tenders received for ash-dust-removing plant for the Greenwich generating station were as below :—

	First section.	Complete plant.
Jas. Keith & Blackman Co., Ltd. (recommended)	£690	£3,507
Shelby Manufacturing Co.	868	3,806
Spencer & Co., Ltd.	1,185	3,888
Matthews & Yates, Ltd.	865	3,991
Buffalo Forge Co., Ltd.	830	4,118

Estimate of chief officer, £3,000.

"The installation of this work is in the nature of an experiment, and arrangements were accordingly made for alternative tenders to be submitted for a part, and the whole, of the work respectively, so that experience might be gained of the working of a part of the plant before the complete installation is made. We have carefully examined the tenders, and we are of opinion that the lowest, that submitted by the James Keith and Blackman Co., Ltd., should be accepted. This firm's tender for the first section of the work amounts to £690, while for the complete installation of the plant their tender amounts to £3,507. The contract will provide for the firm to carry out the first section of the work, and for the installation of the remainder to be undertaken by them, subject to the results and workmanship being satisfactory."

Tenders were invited from selected firms for a lift at 23, Belvedere Road :—

Medway's Safety Lift Co. (recommended)	£295
R. Waygood & Co., Ltd.	344
Smith, Major & Stevens, Ltd.	375
Easton Lift Co., Ltd.	395

The Fire Brigade Committee invited tenders from five selected firms for the electric lighting of the new fire station erecting in Brunswick Road, Poplar, and the following were received :—

G. Harland Bowden & Co.	(recommended)	£157
Waring & Withers		184
G. E. Taylor & Co.		192

The Stores and Contracts Committee has recommended the acceptance of tenders of the following firms for contracts extending from January to December next :—

Electric carbons.—Brush Electrical Engineering Co., Ltd.; W. Geipel and Co.; Ship Carbons, Ltd.
Electric fittings.—Atlas Carbon and Battery Co., Ltd.; Baxter & Caunter; British Ever-Ready Electrical Co., Ltd.; British Insulated and Helsby Cables, Ltd.; Dorman & Smith; Edison & Swan United Electric Light Co., Ltd.; Elliott Bros.; General Electric Co., Ltd.; A. P. Lundberg and Sons; Wm. McGeoch & Co., Ltd.; Plutte, Scheele & Co., Ltd.; Siemens Bros. Dynamo Works, Ltd.; Sunbeam Lamp Co., Ltd.; Veritys, Ltd.; Wm. White & Co.
Electric cables and wires.—British Insulated and Helsby Cables, Ltd.; Hooper's Telegraph and India-Rubber Works, Ltd.
Electric lamps.—British Tungsten Lamp Co., Ltd.; Cryselco, Ltd.; Edison and Swan United Electric Light Co., Ltd.; Pope's Electric Lamp Co., Ltd.; Siemens Bros. Dynamo Works, Ltd.

Nelson.—The T.C. has accepted the tender of Messrs. A. L. Gibson & Co., of Twickenham, for the supply of steel roller shutters at the local car-shed.

Scarborough.—The tender of Messrs. Walker & Hutton, Scarborough, has been accepted by the Corporation for the installation of an electric lighting plant at Cayton Bay Waterworks.

Sheffield.—The City Council has accepted the following tenders :—

Gilbert Heathcote & Co.—Roof principals and supports for extensions to Neepsend power-house, £1,786.
Firth, Blakey, Sons & Co.—Four coal-shoots, Neepsend power-house, £1,670.
British Insulated and Helsby Cables, Ltd.—1,140 yards of figure-8 hard-drawn bronze trolley wire, 8½d. per lb.

Shipley.—The U.D.C. has accepted the tender of Mr. John Wade for 500 tons of Bower's Smudge coal for the electricity works; and that of Messrs. Fyfe, Kemp & Co., for 500 tons of similar coal.

Stretford.—The U.D.C. has accepted the following tenders :—

General Electric Co., Ltd.—Equaliser and diverting gear, complete, with one 800-ampere "Aron" meter, £78.
Drennan, Glover & Cooper.—Cable, £39 12s.
W. T. Glover & Co.—Cable, £13 and £24.

Walsall.—The T.C. has accepted the following tenders for annual supplies for the Tramways Department :—

Micanite and Insulators Co., Ltd.—Micanite rings and mica segments.
A. G. Engholm.—P. & B. tape and paint, and Blackley tape.
British Insulated and Helsby Cables, Ltd.—Mechanical ears.
W. B. Brown & Co. (Bankhall), Ltd.—Galvanised strand wire.
Dyer & Young.—Armature coils.
Edison & Swan United Electric Light Co., Ltd.—Lamps.
Glacier Anti-Friction Metal Co., Ltd.—Bearing metal.
National Rail and Tramway Appliances Co., Ltd.—Brake blocks.
British Hele-Shaw Patent Clutch Co., Ltd.—G.E. 58 pinion wheels.
Anti-Attrition Metal Co., Ltd.—Trolley wheels.

The T.C. has also accepted the tender of Messrs. Babcock & Wilcox, Ltd., for a boiler, at £1,339; and that of the Underfeed Stoker Co. for one of their stokers, at £267.

West Ham.—The Education Committee received the following tenders for the installation of electric lighting at Salway Place School :—

J. T. Halsey.—(*a*, Stannos system), £223; (*b*, Simplex system), £178 10s. 6d.
Johnson & Phillips.—(*a*) £217; (*b*) £204 10s.
W. E. King.—(*b*) £273 1ts. 6d.
Mayfield & Co.—(*a*) £200 18s. 2d.; (*b*) £185 4s. 3d.
Parry Mell.—(*a*) £180 10s.; (*b*) £195 10s.
E. Morgan.—(*a*) £149; (*b*) £151 10s.
Newbald & Co.—(*a*) £220; (*b*) £199.
Ryan & Son.—(*a*) £270; (*b*) £210.
Simmons & Co.—(*a*) £230; (*b*) £238.
Weston & Sons.—(*a*) £230; (*b*) £159 10s.
West Ham Electricity Department (provisionally accepted for *b*).—(*a*) £190 17s.; (*b*) £146 2s.

Wigan.—The T.C. has accepted the tender of the General Electric Light Co., Ltd., for the battery scrap at the electricity works.

THE ELECTRICAL ENGINEERS
(LONDON DIVISION).

THE following orders are issued :—

Commanding Officer—COL. H. M. LEAF.

Monday, December 19th.—"A" Company. Technical drill, 7 to 10 p.m.
Tuesday, December 20th.—"B" Company. Technical drill, 7 to 10 p.m.
Headquarters will be closed for the Christmas holidays from December 21st to January 4th, 1911, both days inclusive. The Orderly Room will be open on week-days from 10 a.m. to 4 p.m., except on Saturdays and bank holidays, when it will be entirely closed.

(Signed) P. H. CAMPBELL, Capt. R.E., Adjutant.

FORTHCOMING EVENTS.

North-East Coast Institution of Engineers and Shipbuilders.—Friday, December 16th. At 7.30 p.m. At the Lit. and Phil. Society, Newcastle. Resumed discussion on Mr. D. B. Morrison's paper on "The Economical Working of Reciprocating Marine Engines and their Auxiliaries."

Institution of Electrical Engineers (Newcastle Section).—Monday, December 19th. At 8 p.m. At the Armstrong College, Newcastle. Discussion on "Switchgear and the Isolation of Faults on Power Systems," to be opened by Mr. H. W. Clothier.

Institution of Electrical Engineers (Manchester Local Section).—Tuesday, December 20th. At 7.30 p.m. At the University, Manchester. Paper on "Merz-Price and other Discriminative Protective Apparatus for A.C. Circuits," by Messrs. K. Faye-Hansen and G. Harlow.

Physical Society.—Tuesday, December 20th. From 3 to 6 p.m. and from 7 to 10 p.m. At the Imperial College of Science, South Kensington. Sixth Annual Exhibition of Electrical, Optical and Physical Apparatus (see "Notes"). Short experimental discourse on "Detectors" in the afternoon and also at the evening session, by Dr. J. A. Fleming.

Junior Institution of Engineers.—The sixth lecture on "Law Relating to Engineering," announced for December 19th, has been postponed to January 30th, 1911.

NOTES.

The Physical Society's Annual Exhibition.—This exhibition, which is to be held on Tuesday, the 20th inst., will be open in both the afternoon (from 3 to 6 p.m.), and the evening (from 7 to 10 p.m.). Prof. J. A. Fleming, F.R.S., will give a discourse at 5 and again at 8 p.m., on "Some Improvements in Transmitters and Receivers for Wireless Telegraphy"; and Mr. R. W. Paul will give a number of cinematograph demonstrations of some physical phenomena. The following firms will be exhibiting :—Messrs. R. and J. Beck, Ltd., British Radio-Telegraph and Telephone Co., Ltd., Cambridge Scientific Instrument Co., Casella & Co., A. C. Cossor, Ltd., H. W. Cox & Co., Ltd., Crompton and Co., Ltd., J. H. Dallmeyer, Ltd., Elliott Bros., Everett, Edgcumbe and Co., Gallenkamp & Co., Gambrell Bros., J. J. Griffin & Sons, Hicks & Co., A. Hilger, Ltd., India-Rubber, Gutta-Percha and Telegraph Works, Ltd., Marconi's Wireless Telegraph Co., Leslie Miller, Muirhead & Co., Nalder Bros. & Thompson, Negretti & Zambra, Newton & Co., R. W. Paul, W. G. Pye & Co., Strange & Graham, H. Tinsley, Townson & Mercer, Weston Electrical Instrument Co., Wright & Co., Carl Zeiss. We understand that invitations have been given to the Institution of Electrical Engineers, the Faraday Society, the Optical Society, and the Röntgen Society. Admission will be by ticket only, and therefore members of the societies just mentioned (including also the Physical Society) desiring to attend the Exhibition should apply to the secretary of the society to which they belong.

The German Electrical Steel Industry.—The report of the Stahlwerke R. Lindenberg Gesellschaft, of Remscheid, for 1909-10, states that the new special qualities of steel produced and placed on the market for materials for war and peace, have met the requirements demanded of the company. During the year additional attention was devoted to the further improvement of the electric smelting process, and new metallurgical processes were worked out, and patents applied for in all industrial countries. The interest manifested by the large iron and steel works in regard to the introduction of the electrical manufacture of steel, was also very marked in 1909-10. Among others an important south-west German works had acquired a licence from the company, and furnaces of from 12 to 15 tons capacity were to be installed, it being intended to substitute electric smelting for the manufacture of open-hearth steel. The Elektrostahl Gesellschaft, which is a subsidiary of the Lindenberg company, had again been able to conclude contracts with important foreign iron and steel works in regard to licences. At the present time, the report remarks, there are 23 electro-steel furnaces on the company's system in operation, representing an annual output of 225,000 tons; and 17 furnaces are in course of construction, three of which will have a capacity of 20 tons each.

London Electrical Engineers.—About 10 officers and 200 men of the London Electrical Engineers, Territorial Force, under the command of Major A. E. Le Rossignol, proceeded to Sheerness on Saturday last for week-end training. The work undertaken was the same as the corps would have to do in war time, and consisted in running the defence electric lights from dusk to dawn. Everything was done under mobilisation conditions, and the men who were not actually on duty rested in the war shelters. The detachment returned to London on Sunday.

Proposed Optical Convention in 1912.—A general meeting of opticians and others interested was held on November 29th, to consider the desirability of making arrangements for the holding of an Optical Convention in 1912. The chair was taken by Dr. R. T. Glazebrook, C.B., F.R.S., as chairman of the permanent committee. A resolution was carried, *nem. con.*, that provided sufficient financial support is obtained, an optical convention be held in the spring or early summer of 1912. An organising committee was nominated to undertake the work of making the necessary arrangements for the convention.

Northampton Polytechnic Institute.—The prizes and certificates for the session 1909-10 were distributed to the successful students of the above Institute by Lord Alverstone on Thursday last week. The chair was taken by Mr. L. B. Sebastian, chairman of the governing body.

The Principal (Dr. R. Mullineux Walmsley) in his report of the work of the session, briefly referred to the outstanding features of the work done and the general progress of the Polytechnic, chief of which on the educational side was the installation of the new generating station as a part of the equipment of the electrical engineering department. A fully-illustrated description of this generating station recently appeared in the ELECTRICAL REVIEW. The total cost of the station was a little over £6,000, towards which the London County Council contributed £5,600. The Principal pointed out that the pressure for adequate accommodation on the educational side was still severely felt in the technical optics department, where the temporary accommodation hired some five years ago in the British Horological Institute was still all that could be placed at the disposal of the department. The day classes and courses had been well maintained, and for the sixth year in succession the Principal had been able to place, without any payment or premium, the whole of the second and third-year students in commercial workshops during the summer. This continued success was due to the thoroughness of the training which the students underwent before they were sent out into the workshops; this opinion was confirmed by the very appreciative reports which were received from the various firms. The Principal explained with regard to the Board of Education's examinations that, although the whole of the work was recognised by the Board, only the examinational subjects of magnetism and electricity were prepared for in the Institute classes, and that only in the classes which were confined to Post Office telegraphists.

Lord Alverstone, in presenting the prizes and certificates, delivered a bright and racy speech, in which he gave sound advice to the students and prize-winners, and stated that in his opinion the curriculum of technical schools must advance. He also said that after the elementary grounding, specialisation was most necessary at the present day. He took the subject of electricity as an instance of the strides that science had taken in the last few years, and how these advances called for new apparatus and greater application on the part of the students. He concluded his remarks by advising them not to be discouraged by mistakes, as it had been well said by somebody, "Men who never make mistakes never make anything at all."

The usual votes of thanks concluded a very pleasant and interesting evening. The conversazione was continued on the following evening, as usual.

Supply Authority and Contractor.—"One of the most successful central station managers in America, when asked recently how he contrived to get along so well with the local contractors (there is great harmony between the two interests), briefly replied:—'I make them toe the mark, and I give them a square deal—that's all.' And it was enough, for in this short, crisp sentence were contained all things that make for perfect co-operation between two branches of the trade that must work together if the best interests of both are to be furthered. This manager recognises that if certain things are due to his company, certain other things are due to the contractors, and he is big enough and fair enough to see to it that both get what they are entitled to. He has stringent rules applying to the installation of work, and he makes the contractors 'toe the mark' every time; he has a clear conception of the rights of the contractor, and he hands him out a 'square deal' every time. He maintains an energetic soliciting staff, but he does no construction work, believing it not a proper function of the central station to install wiring equipments in towns where competent contractors can be found.

"When a contract is secured by this company, either for light or power, the customer is given a list of all the local contractors who have proved their ability and willingness to perform good work, and is told to apply to any or all of them for his wiring; all the central station is concerned with is having the work done right. The sale of wiring supplies is, of course, left entirely in the hands of the dealer. In order to develop the motor business, which was practically non-existent, and which he realised the contractors were unable to handle, this manager some years ago organised a motor-selling department and built up a large trade, keeping in stock as much as $50,000 worth of goods. The business established on a firm basis, he turned it over to the contractors, who in the meanwhile had gained some valuable experience. He is not a philanthropist, this manager; he is a business man of rare sagacity. He also is an example, for his policies, of which co-operation with the contractor is not one of the least effective, have made his company not only one of the most prosperous in the country, but, at the same time, one of the comparatively few public service corporations that possess the goodwill of the local community, which last form of asset, by the way, is not one of the least valuable that can be possessed by a corporation providing public service."—*Electrocraft.*

Lead.—A correspondent of the *Financial Times* says that the immediate outlook for the International Lead Convention has latterly been improved, as a result of an increased demand on the part of European electrical goods manufacturers. "This has enabled the Convention to dispose of a proportion of the somewhat heavy surplus stocks which had previously been accumulated in the course of the operations entered into with the view of supporting the market. The exports have also been on a larger scale, and at practically all points stocks are understood to have undergone a curtailment, despite the fact that the Australian supplies have increased to the neighbourhood of the normal, and that the demand on American account has been light. Prices have accordingly shown an upward tendency, although at round £13 per ton they can still only be described as moderate. Ever since its inception in the early part of last year the International Convention has had many difficulties to contend against. It is handicapped in its operations fundamentally by the fact that it controls less than 50 per cent. of the world's total output of, roughly, 1,000,000 tons. Indeed, it is stated in some quarters to control not more than 300,000 tons, of which 120,000 tons is contributed by certain Spanish mines, 40,000 tons by the Hoboken Works, near Antwerp, and 130,000 tons by Australia, 10,000 tons emanating from Germany. If the main object of the Convention was to advance prices to the advantage of producers it has signally failed, and the continuation of the Convention is regarded as extremely problematical. Its constitution took place as the outcome of protracted negotiations conducted in Paris in the early part of last year. The agreement entered into was to extend up to the end of 1910, when any of the parties thereto were to be entitled to withdraw on giving six months' notice. No minimum prices were fixed, the idea being that values should be regulated by a sliding scale of production. As, however, there were so many important producers left outside of the Convention its control proved from the outset somewhat feeble, although it was contended, when its opponents triumphantly pointed to the fact that during the first year of its existence lead prices had been actually lower than in the preceding year, that had it not been for the operations of the Convention values would probably have been at least £2 per ton lower."

Late Correspondence.—Mr. William P. Durtnall, M.I.Mar.E., writes as follows regarding the patent inquiry "Durtnall *v.* British Thomson-Houston Co.," reported on page 937 of our last issue:—

"I notice in the report on the above case that appeared in your journal on December 9th last, a slight, but possibly misleading, statement, which I trust you will kindly allow me to correct. You state that Mr. Durtnall asked the Comptroller to say that the respondents were using his combination, which he had previously patented in 1905, without mentioning it in the specification. Of course, it is not possible to have a valid patent without mentioning the matter clearly in a patent specification, but you mean, possibly, that the respondents did not mention my patented system in *their* specification, nor did they make any disclaimer to the effect that such a combination of high-speed turbines or other prime movers, being arranged to drive polyphase alternating-current generators (with fixed armatures) supplying current to 'slow-speed propellers' for ship propulsion, thus forming an electrical speed reduction gear, and I drew attention to this, and pointed out that a great reduction in steam was possible by arranging such plant accordingly. My patent 17,248, 1905, has been granted in 19 countries, and was the first to show such a arrangement, and, therefore, is a master patent for this 'system' of plant for propelling ships.

"As regards the adding on of a low-pressure turbine as proposed by the respondents, this I did not claim. Nor am I likely to, for reasons which I have already many times pointed out before the technical institutions, and in the engineering Press, in this country and abroad. The only thing opposed, was the fact that the respondents were proposing to use my system as part of their combination, without disclaimer, or with my permission. As you may be aware, I successfully opposed Mr. Parsons on this point a few months ago."

An Electrical Prize Problem.—The Association of German Mechanical Engineers has just announced the report of the prize committee on the result of the present year's Beuth problem concerning the utilisation of a railway power station for auxiliary works. Competitors were confronted with the problem of a double-track main line operated electrically and having a length of 102 miles. The power station, which is intended for the production of single-phase current of 15 periods, is assumed to be in the middle of the section, and contains seven generators of 3,000 KW., driven by steam turbines and having a terminal pressure of 3,000 volts. Five of the generators are to be kept in constant operation, and the terminal pressure is kept at the same value by automatic alteration of the excitation. The working of the railway requires 40,000,000 KW.-hours annually, with a peak load of 18,000 KW. In order to render of use the surplus output which is available when the machines are fully loaded, 50,000,000 KW.-hours of it are to be employed for the production of electrical steel (for special castings), and 10,000,000 KW.-hours for the supply of various localities in the vicinity of the railway with direct current for lighting and power purposes. The electrical supplies in question are to be measured at the bus-bars in the generating station. The steel works is situated not far from the power station. The apparatus for collecting the surplus power from the network of the railway must be of such a kind as to be able to accommodate its consumption to the demand made upon the power station at any time by the working of the railway. As fuel, lignite is available at the price of 2s. per ton in the immediate neighbourhood of the power station. In order, however, to increase the economy, the fuel is not to be used directly as lignite, but only after it has been carbonised for the recovery of by-products (tar, paraffin, &c.), and is then either used as lignite coke or in the form of producer gas. The price of energy, including interest and depreciation charges, would be 2½ pfennigs per KW.-hour if the firing were effected with crude lignite, and on the assumption that only the 40,000,000 KW.-hours needed for operating the railway were produced. Competitors were required to submit a plan of the installation, an explanatory report with

sketches of the plant for the electric steel installation, a correct statement of an alternating-direct current distributing installation, a statement of the apparatus for accommodating the collection of current to the prevailing demand on the power station by the working of the railway, a representation of the coking and by-product recovery plant, and details of the cost of production. The competition has only elicited four solutions. Herr Ackermann, of Kattowitz, has been awarded the first prize of the Beuth gold medal and the State prize of £15, and Herr Max Kreyssig, of Halle, the second prize represented by the Beuth gold medal.

Canadian Water-Powers.—The total available H.P. of the rivers of Canada is stated to be 25,682,907 on the basis of minimum flow development. Of this total only about 2 per cent. (516,887 H.P.) is now developed. The distribution of the water-powers in the various provinces is as follows, the figures representing H.P.: Yukon, 470,000; British Columbia, 2,065,500; Alberta, 1,144,000; Saskatchewan, 500,000; Manitoba, 504,000; North-West Territories, 600,000; Ontario, 3,129,168; Quebec, 17,075,939; New Brunswick, 150,000; Nova Scotia, 54,300. In January there will be submitted to the Dominion Parliament a Bill respecting the water-powers of Canada. The objects of the law came under seven heads as follows: (1) Water-powers to be alienated for stated periods only. (2) Reference of the application for water-powers is to be made to the Conservation Commission before alienation. (3) Determination of the development to be made, and the right of entry and the annual rental calculated on the horse-power used. (4) Time within which proposed development is to be made, and forfeiture in case of non-observance and revision of rentals at expiry of each period. (5) Indemnification of lessee in case of failure to agree after each period. (6) Control of rates at which the public at large is to be supplied with electric power by the lessee. (7) Jurisdiction to determine differences between the Government and lessees in case of failure to agree in some independent tribunal.—*Electrical World.*

Educational.—BATTERSEA POLYTECHNIC.—A course of 12 lectures on "Electrical Costs and Quantities" will be given by Mr. W. Brew on Thursday evenings, at 7.30, commencing January 19th, 1911. Courses of lectures in electric traction, design of alternating-current machinery, and alternating and direct currents will also be given, commencing January 9th, 1911. For further particulars, see our advertisement pages to-day.

Appointment Vacant.—Electrician-attendant for the County Asylum, Rainhill, near Liverpool (£50). See our advertisement pages in this issue.

Metropolitan Association of Electric Tramways Managers.—A meeting of the members of this Association was held on Friday, 9th inst., at the Municipal and County Club, Whitehall Place, Whitehall, S.W., when there were present: Mr. H. E. Blain, West Ham; Mr. A. G. Balfour, Dartford; Mr. A. Coveney, Eritb; Mr. H. L. Howard, Barking; Mr. C. Mittelhausen, Bexley Heath; Mr. F. Schofield, Leyton; Mr. W. C. Ullmann, East Ham; Mr. W. E. Hammond, Metropolitan Electric; Mr. A. V. Mason, South Metropolitan; and Mr. T. B. Goodyer, Croydon. Mr. A. H. Stanley was unanimously elected chairman, Mr. H. E. Blain vice-chairman, and Mr. T. B. Goodyer hon. secretary for the ensuing year. It was reported that the work in connection with the formation of the Central Claims Bureau was proceeding most satisfactorily, and that there was every hope that the Bureau would come into existence early in January next.

Foreign Trade in November.—The improvement in our foreign trade continued in the month of November. The imports increased by nearly 2½ millions sterling, and the exports by more than 3½ millions, while the re-exports were better by over £700,000 than for the corresponding month of 1909, the percentage gains being 4·02, 10·73, and 10·46 per cent. respectively. The imports of electrical goods and apparatus, other than machinery and telegraph and telephone wire, amounted in value to £45,738 more, and the exports of electrical goods to £39,356 more than in November, 1909. The figures for the 11 months show an improvement of £1,561,406 in electrical exports down to date. The gross increase in all exports for the same period is between 48 and 49 millions sterling.

The value of the electrical apparatus and electrical goods exported from the United Kingdom in the first 11 months of this year was £3,512,562, as compared with £1,951,156 in the corresponding period of 1909, and £1,787,685 in the corresponding period of 1908. In the total of £3,512,562 rubber insulators figured for £408,275; insulators, other than rubber, for £327,670; telegraph and telephone cables, for £1,847,547; telegraph and telephone apparatus, for £208,379; carbons, for £16,792; electric glow lamps, for £115,766; arc lamps and searchlights, and parts thereof, for £33,786; primary and secondary batteries, for £110,227; and unenumerated electrical goods and apparatus, for £440,020.

The Electric Eye.—The *Daily Express* correspondent in St. Petersburg announces that Prof. Rosing, of the Institute of Technology, claims to have constructed an electro-telescopic apparatus which will enable the owner to see anything and anyone he chooses, even a long distance away from the observer. We doubt whether such an invention would have a favourable reception from the public—certainly, Bill Sikes and his kind would have a strong prejudice against it. If this sort of thing goes on, we fear that before long someone will invent a device to enable us "to see oorsels as ithers see us"—which Heaven forbid!

P. & O. Batti-Wallahs' Society.—The Birmingham Section of this Society held their second function of the season—a very successful ball—under the chairmanship of Mr. R. A. Chattock, the city electrical engineer and manager, on Friday, December 2nd, at the Grand Hotel, Birmingham. The event took place in the magnificent Grosvenor Room. Supper was provided at the interval, and some 130 ladies and gentlemen sat down. At the conclusion the chairman, who was heartily received, remarked that it was not usual to make speeches at suppers of this kind, but the Batti-Wallahs always did things out of the common, and he could not let this opportunity go by without saying how pleased he was to see so many friends round him. He asked them to drink to the health of the King, which was heartily responded to, with musical honours, led by Mr. H. Foulds. The Batti-Wallahs' next function—a smoking concert—is announced for January 19th.

Institution and Lecture Notes.—INSTITUTION OF ELECTRICAL ENGINEERS (GLASGOW LOCAL SECTION).—The members of the Local Section held their annual dinner in the Grosvenor Restaurant, Glasgow, on Wednesday, December 14th, under the chairmanship of Mr. Sam Mavor, local president. Prof. Barr (Glasgow University) proposed "The Imperial Forces," and replies came from Mr. C. H. Wordingham (superintendent electrical engineer to the Admiralty) and Sir J. H. A. Macdonald (the Lord Justice Clerk for Scotland). Sir Donald MacAlister, K.C.B. (principal of Glasgow University) submitted "The Institution of Electrical Engineers," which Mr. Ferranti, the president, acknowledged, while the toast of "The Local Section" was pledged by Mr. W. H. Patchell, member of the Council of the Institution, the chairman responding.

THE INSTITUTION OF ELECTRICAL ENGINEERS.—At the conclusion of last week's ordinary meeting, a special general meeting was held, at which the action of the Council in borrowing £11,500 on the security of the property of the Institution (see page 915) was unanimously approved.

ROYAL INSTITUTION.—We have now received the printed official programme of arrangements for the next few months. On Friday, January 20th, Prof. Sir J. Dewar will lecture on "Chemical Changes at Low Temperature"; on January 27th Prof. W. H. Bragg will lecture on "Radioactivity as a Kinetic Theory of a Fourth State of Matter"; March 31st, Prof. H. S. Hele-Shaw on "Travelling at High Speeds on the Surface of the Earth and above it"; April 7th, Prof. Sir J. J. Thomson, on "A New Method of Chemical Analysis." Six Saturday afternoon lectures on "Radiant Energy and Matter" will be delivered by Sir J. J. Thomson on March 4th, and five following Saturdays. To Prof. S. P. Thompson's Christmas course of juvenile lectures on "Sound," commencing on December 29th, we have already referred.

BIRMINGHAM ELECTRIC CLUB.—At the annual meeting of the club on Saturday last, the sixth annual report stated that there were about 85 members on the club register. The finances were in a satisfactory condition, and there was a balance in hand.—Mr. F. W. Foster was elected president for the coming year.

Mr. D. Maxwell recently lectured at Dundee to a large audience on "Some Interesting Applications of Electricity."

Chichester Electric Light and Power Co., Ltd.—The secretary of this company (Mr. F. D. Pepper) writes as follows from 7, Victoria Street, Westminster, S.W., under date December 14th:—"The attention of my board having been called to a notice in the Press of the voluntary winding-up of 'The Chichester and District Electric Supply Co., Ltd.,' I have been directed to ask the favour of your giving publicity to the following facts:—That this company is the only body authorised to undertake the supply of electricity in Chichester, its powers being derived from a provisional order transferred to it by the Corporation of Chichester, and that this company is not, and never has been, in any way associated with the concern above referred to, or with any person connected therewith."

Electric Supply Company Summoned.—On Wednesday at the Marlborough Street Police Court, before Mr. Denman, the London Electric Supply Corporation appeared in answer to an adjourned summons for having made default in supplying energy to Robert Henry Hummell, of 6, Old Bond Street. Mr. Newbolt appeared for the complainant, Mr. Marriott represented the Supply Corporation, and Mr. W. S. Kennedy was present to watch the case on behalf of the Westminster Electric Supply Corporation. Mr. Marriott said that his company had the right to supply either continuous or alternating current, but they had not the mains in Bond Street to supply anything but the alternating current. Mr. Newbolt said it was common ground that the company had not supplied his client with any energy. They took up the position that they were tied hand and foot to the Westminster Co., and that they were bound to take whatever the latter company might give. His point was that the London was the only company that could give them the continuous current, and he contended that if it had not been for the agreement entered into between the two concerns, they would have had it. The Magistrate reserved his decision.

Radium in Bulk.—Sir Ernest Cassel has presented the English Radium Institute with no less than a whole gramme of radium, at a cost of £15,000—a price specially reduced by the makers (the Austrian Ministry of Works) on account of the large quantity purchased. It will be used for cancer research.

The City Lighting.—We have received from Mr. Frank Bailey full particulars of the recent developments in connection with the public lighting of the City by the City of London Electric Lighting Co., Ltd., and will deal with them fully in our next issue.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—In response to an application from the deputy borough electrical engineer, the Newport (Mon.) Electricity and Tramways Committee recommended that his maximum salary be increased from £250 to £300 per annum, to be reached by yearly increments of £20. The Committee also recommend that the maximum salary of MR. J. P. BROWN, first-class clerk, be raised from £130 to £150 per annum.

MR. A. C. BOSTEL, assistant sales manager of the Birmingham Corporation electricity department, has been appointed sales superintendent of the Croydon Corporation electricity works. The appointment was not advertised. With that in view, an amendment was moved at the Croydon Council meeting on Monday, but it was lost. Mr. Bostel held a post under the Croydon Council before going to Birmingham.

The Burton-on-Trent Electricity Committee has appointed MR. MELBOURNE to be chief assistant, at a salary of £130.

The electrical engineer of West Ham, as a temporary measure, has appointed MR. SEDDON and MR. MACKENZIE as electrical and mechanical superintendents respectively, at the same salaries as before. This arrangement is to be further considered at the end of the present financial year.

General.—The Lancaster T.C. has appointed MR. L. BARBER as teacher of the electric wiring class at the Storey Institute.

MR. F. W. SMITH (F. W. Smith & Co. (1907), Ltd., electrical engineers, Manchester and Southport) announces that he has adopted the name of Cleburne, and will in future be known as F. W. Smith-Cleburne, but the name of the firm remains unaltered.

MR. F. B. O. HAWES has resigned the managing directorship of the Langdon-Davies Motor Co., Ltd., and is now consulting engineer to that company. The large increase in work devolving upon him in connection with the National Electrical Manufacturers' Association, and other matters with which he is connected, render it impossible for him to continue in his old capacity with the company.

MR. A. E. TANNER, who has been a member of the staff of Messrs. W. T. Glover & Co., Ltd., for a number of years has been elected a director of the company.

Obituary.—MR. JAMES R. BARR.—We deeply regret to announce that Mr. James R. Barr, A.M.I.E.E., who was to have read a paper before the Glasgow Section of the I.E.E. on December 13th on "Some Considerations Relating to the Parallel Working of Alternators," passed away last week. In consequence of this sad event, the meeting was cancelled, and the reading and discussion of the paper are adjourned *sine die*.

SIR CHARLES SCOTTER.—By the death of Sir Charles Scotter, the always good-humoured chairman of the London and South-Western Railway, the railway world has lost one of its leaders of whom and whose career it had great reason to be proud. Sir Charles came more directly within our own sphere by his connection with the little Waterloo and City deep-level electric tube line, which was for years run as a separate company, but was of real assistance to the L. and S.W. Railway, and was eventually absorbed as part of that undertaking. In the early stages of the Great Northern and City Railway, Sir Charles was chairman of that concern also.

CITY NOTES.

Manx Electric Railway Co., Ltd.

THE eighth ordinary annual general meeting of the above company was held on Tuesday at the offices, 3, Finch Lane, E.C., under the chairmanship of Mr. A. G. Boscawen.

In moving the adoption of the report, the CHAIRMAN said the gross receipts were £165 lower than last year. The gross expenditure was £801 higher. Both the decrease in the total receipts and the increase in the total expenditure were attributable to the same cause, viz., the fact that one of the company's tenants was not able to carry out the terms of his lease. Owing to this their hotels were untenanted during the dead season of the year, and the loss in rent alone amounted to £702, whilst, on the other hand, redecoration and repairs to hotels caused an extra expenditure of £160. The Laxey Gardens had to be worked by the company itself, instead of being in the hands of a lessee, as in previous years, at a fixed rental, and expenditure had to be incurred in connection with the gardens in providing bands, &c., which came to £622. Had it not been for this misfortune they would have made a better showing than last year, for both passenger and goods receipts were higher—the former by about £120 and the latter by about £50; whilst the total expenditure, but for the items he had mentioned, would have come out just about the same as last year. This extra expenditure would not recur in future years, for the company had given up the tenancy of Laxey Gardens, and their own hotels were again let to a well-known substantial firm of caterers, who were doing the thing well and would give thorough satisfaction to customers. The ratio of working expenses to receipts had been affected by the circumstances he had referred to, but had it not been for them the ratio would have been about 50 per cent., as against 50·3 per cent. last year. The passengers carried were 533,104 as against 518,655 last year, an increase of 14,449, but the traffic had been worked on a decreased train-mileage of 5,381 miles for passengers, and 3,314 miles for goods. In other words, the traffic receipts this year amounted to 1s. 8½d. per train-mile as against 1s. 7½d. last year, which was a proof that further economy had been successfully studied in the working of the line. The average receipts per passenger this year were 13·2d., which was a falling off from last year, whilst last year was a falling off from the year before that. The figures for the two previous years were respectively 13·5d. and 13·8d. This continuous decrease seemed to show that the average visitor to the island had become more and more careful in his expenditure. It seemed that his spending power was not so great as in former years, and he contented himself with shorter trips on the railway. They had not added anything this year to the reserve fund, which stood at £5,316. It was represented by investments which cost £5,194, at which sum they stood in the books, although their present market value was £5,294. The small uninvested balance of the reserve fund was, of course, cash, and waiting to be invested on some future occasion. They had paid an interim dividend of 2¾ per cent. on the 5½ per cent. cumulative preference shares, and proposed paying the balance forthwith, leaving £236 to be carried forward.

SIR W. H. VAUDREY seconded the motion, and the report was adopted without discussion.

Hong Kong Tramway Co.

IN the Chancery Division on Tuesday Mr. Justice Neville had before him a petition to confirm the reduction of the capital of the Hong Kong Tramway Co., Ltd., and Reduced.

MR. JENKINS, K.C. (with him Mr. J. W. M. Holmes) said the company was formed in 1902, to acquire the whole of the share capital of a former company, which was called the Electric Traction Co. of Hong Kong, which held concessions for tramways in Hong Kong. The capital of the company was £325,000, in ordinary shares of £1 each. The company issued the whole of its shares fully paid up, as vendors' shares. They were not issued for cash, the money necessary for the construction of the tramways being raised by means of debentures. It was now proposed to write 15s. off each of the ordinary £1 shares, which were all vendors' shares.

An independent expert had been sent out to examine the assets, and the evidence of the loss sustained by the company was quite conclusive. In fact, the loss was something considerably more than the amount now being written off.

His LORDSHIP confirmed the reduction.

Manila Electric Railroad and Lighting Corporation.—The directors have declared a dividend of 1 per cent. for the quarter ending December 31st on the total issue of 5 million dollars common stock.

Stock Exchange Notices.—Applications have been made to the Committee to allow the following securities to be quoted in the Official List:—South Metropolitan Electric Light and Power Co., Ltd.: 50,000 6 per cent. cumulative second preference shares of £1 each fully paid, Nos. 300,001 to 350,000.

Winnipeg Electric Railway Co.—The directors have declared a quarterly dividend at the rate of 10 per cent. per annum.

Johnson-Lundell Electric Traction Co., Ltd.—The report states that the accounts for the 16 months to October 31st show a loss of £1,731, increasing the debit balance at profit and loss account to £97,136.

The annual meeting was held on Wednesday, when the balance-sheet was adopted and the usual business transacted. The chairman said that the negotiations were still proceeding for the sale of the patents, and the directors continued hopeful as to the future.

R. Waygood & Co., Ltd.—The directors have declared an interim dividend of 2½ per cent. (6d. per share), less income-tax, on the ordinary shares for the half-year.

India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.

THE directors report that for the year ending September 30th, 1910, the accounts show, after provision for doubtful debts, a net profit of £55,414; adding £55,012 brought forward, and deducting £4,687, the dividend on the preference shares paid in January and July, and £12,500, the dividend on the ordinary shares paid in July, there remains a disposable balance of £93,239; which, after providing for the balance of the dividends proposed for the year, and a special reserve of £30,000 set against stocks, will leave £22,614 to be carried forward. The directors recommend that the payment of the half-yearly dividend of 5s. per share, or at the rate of 5 per cent. per annum, be made to the preference shareholders on January 1st prox., and they further recommend the distribution of a dividend to the holders of the ordinary shares of 15s. per share, free of income-tax, amounting to £37,500, making, with the interim dividend paid in July, a total payment of 10 per cent. for the year. The general business of the company shows an increase compared with the turnover of last year, which is, however, partly due to the higher scale of prices at which some of the company's goods have been sold. Taken as a whole, their foreign agencies have done a profitable business, and the sales of the home agencies have been satisfactory. The prices of some raw materials attained an abnormally high level, but the advances the company were able to make in the selling prices of their goods have, except in the case of the French works, sufficiently met the situation. The stocks, however, are highly priced, and the board have thought it desirable to make the provision mentioned above. The expenditure at the French works to increase the facilities there is not yet completed, but will be during the current year. The electrical industry continues dull. There has been an increase in the submarine cable work during the year, and the company's steamer *Buccaneer* has had fair employment. The works at Silvertown and Persan have been maintained in the usual state of efficiency.

German Electrical Companies.

THE accounts of Siemens Elektrische Betriebe Gesellschaft, of Berlin, which operates various supply undertakings, exhibit net profits of £28,400 for 1909-10, as contrasted with £25,900 in 1908-9. It is intended to pay a dividend of 6½ per cent. for 1909-10, as compared with 6 per cent. in the preceding year.

The Continental Telegraphen Compagnie, of Berlin, records for 1909-10 profits of £3,460 from the telegraphic business, and £3,100 from investments, these comparing with £2,020 and £3,030 respectively in the preceding year. Including the balance brought forward the net profits amount to £6,600, as against £5,080 in 1908-9, and a dividend of 12 per cent. is in contemplation on the share capital of £50,000, this contrasting with 9·6 per cent. in the previous year.

The directors of the Telephon Fabrik A.G. vorm. J. Berliner, of Hanover, in reporting on the working in 1909-10, state that the results were satisfactory. Orders for automatic apparatus were carried out, and the apparatus had been proved by trial, and there was prospect of receiving equivalent orders. Contracts for Government account were constantly on hand, and the branches were well employed. The share in the English and French business was profitable, and the Hungarian undertaking was proposed to be converted into an independent company. After providing £13,400 for depreciation, as compared with £12,300 in 1908-9, the accounts show net profits, including the balance brought forward, of £32,800, as against £31,400 in 1908-9. It is proposed to pay a dividend of 12 per cent., as contrasted with 11 per cent. in the previous year.

The Rhenish Schuckert Gesellschaft fur Elektrische Industrie of Mannheim, reports that the development and results of the company's own supply undertakings or tramways and of those in which it is interested were satisfactory in 1909-10. After allocating £6,200 to depreciation and reserve funds, as against £4,400 in 1908-9, the accounts indicate a net surplus of £22,300, as compared with £23,000 in the preceding year, and a dividend of 7 per cent. is proposed on the ordinary share capital of £200,000, being the same rate as in each of the three previous years. The directors' report refers, among other matters, to the agreement concluded with the Bavarian State mining authorities for the erection of a large power station in the vicinity of the Government mines at Mittelbexbach and St. Ingbert for supply in the Palatinate. Negotiations in regard to the technical and financial execution of the project are now proceeding with the representatives of the local authorities in the Palatinate.

Anglo-Argentine Tramways Co., Ltd.—The directors have declared a dividend on the first and second cumulative preference shares of 2s. 6d. per share, less income-tax, being at the rate of 5 per cent. per annum for the half-year ending December 31st. As from January 1st, 1911, the first and second cumulative preference shares will bear interest at the rate of 5½ per cent., instead of 5 per cent., as at present.

Correction.—Siemens-Schuckert Groups.—In the reference to the above in our last issue, page 954, there is a printers' error in the 1908-9 column of the Siemens-Schuckert Works, the dividend being stated as 40 per cent. instead of 10 per cent.—the same as for 1909-10.

Melbourne Electric Supply Co., Ltd.

THE directors' report for the year ended August 31st, 1910, states that during the year, capital expenditure in Australia on additional land, buildings, plant and mains, &c., has been incurred as follows:—On the Melbourne undertaking, £43,568: on the Geelong undertaking, £6,338 = £49,906. The profit and loss account shows that the gross profit derived during the year from the Melbourne and Geelong undertakings was £21,302. Adding the dividend received on the company's holding of ordinary shares in the Adelaide Electric Supply Co., Ltd., together with discounts, transfer fees, &c., the total gross profit for the year amounts to £28,429, which compares with £29,733 for the previous year. After payment of management and general expenses at the London head office, and interest on debenture stock, there remains a balance to the credit of profit and loss account of £13,675, to which must be added the amount of £3,694 brought forward from the previous year, making a total credit balance of £17,369. Deducting from this sum the dividend on the first preference shares for the half-year ended February 28th, 1910, there remains an available balance of £13,869, which the directors recommend should be applied as follows:—Dividend on 20,000 7 per cent. first preference shares to August 31st, 1910 (paid on September 1st, 1910), £3,500; transfer to depreciation and general reserve account, £5,000; writing down suspense account, £1,966; writing down head office furniture, £50; balance to carry forward, £3,353. During the year a further 7,750 Adelaide ordinary shares have been sold at a profit of £1,033, which has been applied in reduction of suspense account. Since the last annual meeting, the directors have devoted further attention to the question of dealing with the arrears of dividend on the £150,000 6 per cent. cumulative preference stock, amounting at August 31st, 1910, to £80,950. A definite scheme has now been prepared, which has been approved in principle by a number of the principal preference stockholders; and it will be submitted for adoption to extraordinary general meetings of the preference stockholders and ordinary shareholders to be held immediately prior to the annual meeting on 21st inst. The directors regret to report that the serious and prolonged coal strike which broke out in Australia about a year ago, involved the company in heavy extra expense in the purchase of fuel, the effect of which is reflected in the revenue accounts, and is responsible for the check in the hitherto steady annual increase in the gross profit earned at Melbourne. A contract has been made for the supply of electric power from the Melbourne station to the Prahran-Malvern Municipal Tramways Trust. The supply was commenced in June last, and is being maintained satisfactorily. Extensions of the tramways are already in progress, and will involve an increased demand for power. Orders-in-Council for the supply of electricity in the suburbs of Brighton and Camberwell have recently been granted to the company; and distributing mains are being laid in these districts. Negotiations are proceeding with the Town Council of Hawthorn for a lease of their Order-in-Council, with a view to the inclusion of this important and hitherto untouched district in the company's sphere of operations. An agreement has been entered into with the local authorities at Geelong for the establishment of a small system of electric tramways in the town. The work of construction is proceeding, and it is expected that the tramways will be opened for traffic in the course of 1911. The necessary power will be supplied from the company's existing generating station at Geelong, which is well adapted for the purpose. The following table shows the progress made by the Melbourne and Geelong undertakings:—

Date.	Lighting in 30-watt lamps.	Motors in rated H.P.	Total equiv. connections expressed in 30-watt lamps.	Total units sold.	Gross profit.
Melbourne—					
August 31st, 1907 ..	76,278	1,553	125,974	1,820,879	£14,290
August 31st, 1908 ..	90,088	2,150	157,412	2,326,907	16,053
August 31st, 1909 ..	104,900	2,434	182,788	2,716,174	20,573
August 31st, 1910 ..	136,562	3,688	253,538	3,394,525	19,279
Geelong—					
August 31st, 1907 ..	22,150	701	44,582	344,501	£2,064
August 31st, 1908 ..	26,942	818	51,864	312,661	1,623
August 31st, 1909 ..	28,336	893	56,920	364,770	2,439
August 31st, 1910 ..	33,756	994	63,938	413,101	2,022

Mr. F. W. Clements, the company's local managing director and chief engineer, came home on leave during the summer, and the directors had the advantage of conferring with him personally on numerous matters of importance affecting the company's interests in Australia.

Calcutta Electric Supply Corporation, Ltd.—The number of units delivered to consumers during the four weeks ended October 28th, 1910, were 736,085, compared with 686,302 units in the corresponding four weeks of 1909.

Globe Telegraph and Trust Co., Ltd.—The directors have declared an interim dividend of 2s. per share, free of income-tax, on the ordinary shares for the quarter to November 30th.

Canadian General Electric Co., Ltd.—The directors have declared a dividend of 1¾ per cent. on the common stock for the three months to the 31st inst., being at the rate of 7 per cent. per annum.

Eastern Telegraph Co., Ltd.—A third quarterly dividend is announced of 1¼ per cent. on the ordinary stock on account of the year ending December 31st.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	£*	No. of wks.	Total to date. £	£*	Route miles open.	Inc.
Aberdeen	Dec. 7	2,637	+ 229	27	39,491	+ 575	..	..
Ayr	„ 10	346	+ 2	30	10,331	+ 373	8	..
Bath	„ 10	1,360	+ 86	49	39,703	+ 2,058	..	..
Belfast	„ 9	8,063	+ 743	39	147,741	+ 9,175	37	..
Birkenhead	„ 11	2,173	..	36	40,196	+ 986	13·68	..
Birmingham Corp.	„ 3	13,855	+ 632	35	240,053	+ 4,937	56·79	..
Blackburn	„ 7	1,879	+ 61	36⅔	39,341	— 1,383	14·12	..
Blackpool Corp.	„ 8	734	+ 45	..	49,623	+ 340	..	..
Blackpool-Fleetw'd	„ 10	436	— 14	23	23,948	+ 633	..	..
Bolton	„ 4	4,384	+ 81	36	84,534	+ 442	26	..
Bournemouth	„ 7	2,624	+ 194	35⅔	67,072	+ 5,172	21·95	..
Bradford	„ 3	9,376	+ 454	36	181,649	+ 7,235	54·8	..
Brighton	„ 11	1,510	+ 57	36⅔	37,162	+ 301	9·5	..
Bristol	„ 9	11,056	+ 653	..	..	..	..	..
Brit. Elec. Trac. Co.								
Airdrie	„ 2	412	— 9	48	10,532	+ 61	3·65	..
Barnsley	„ 2	326	— 3	48	8,284	+ 193	..	..
Barrow	„ 2	420	+ 20	48	12,737	+ 1,611	5·37	..
Cavehill	„ 2	117	+ 16	48	4,326	+ 234	..	..
Devonport	„ 2	785	+ 124	48	20,509	+ 2,916	8·85	..
Gateshead	„ 2	1,923	— 21	48	47,653	— 66	11·25	..
Gravesend	„ 2	380	+ 7	48	9,962	— 152	6·5	..
Greenock	„ 2	894	— 77	48	29,473	+ 2,860	7·25	..
Hartlepool	„ 2	381	— 44	48	11,828	+ 518	6·72	..
Kidderminster	„ 2	167	— 13	48	5,315	+ 146	..	..
‡Leamington	„ 2	260	— 63	48	8,150	— 354	..	..
Merthyr	„ 2	350	— 13	48	9,913	— 146	2·9	..
Metropolitan	„ 2	13,280	+1,541	48	359,870	+60,745	22	..
Middleton	„ 2	533	+ 8	48	15,143	— 835	8·5	..
Mid. Joint Com'tee	„ 2	10,832	+ 133	48	234,888	+ 4,092	..	..
Oldham—Ashton	„ 2	1,013	+ 12	48	26,667	— 220	9·13	..
Peterborough	„ 2	190	..	48	5,591	— 90	5·31	..
Potteries	„ 2	3,780	— 20	48	86,097	— 490	29	..
Rothesay	„ 2	75	— 2	48	9,990	+ 163	2·75	..
Southport	„ 2	441	+ 28	48	14,074	+ 315	8·17	..
S. Metropolitan	„ 2	1,230	— 102	48	39,378	+ 1,100	..	..
Swansea	„ 2	1,959	+ 10	48	52,114	+ 5,185	12·5	..
Tynemouth	„ 2	262	+ 8	48	12,185	+ 535	3·75	..
Weston-s-Mare	„ 2	45	— 8	48	7,089	— 26	3	..
‡Worcester	„ 2	464	+ 6	48	13,625	+ 258	5·75	..
Wrexham	„ 2	171	— 4	48	4,665	— 55	..	..
Yorks. Wool. Dist.	„ 2	1,794	+ 18	48	47,557	+ 3,266	17	..
Miscellaneous	„ 2	333	— 90	48	10,227	+ 198	..	..
Burnley	„ 10	2,410	+ 153	..	..	..	11·73	1
Burton-on-Trent	„ 11	550	+ 53	36	10,015	+ 241	6·64	..
Bury	„ 11	2,163	+ 156	36⅔	43,090	+ 117	22·5	..
Cardiff	„ 3	4,059	+ 8	36	80,477	+ 973	..	..
Carlisle	..	..	..	..	..	..	..	..
†Chatham and Dist.	„ 1	1,412	+ 5	48	40,956	+ 1,425	14·98	..
Cork	„ 8	966	+ 44	49	23,870	+ 1,841	9·89	..
†Croydon	Nov. 25	2,822	— 43	..	57,989	+ 3,342	11·25	..
†Darlington	Dec. 3	203	+ 23	36	7,246	+ 584	..	..
Darwen	„ 2	468	— 16	35	8,795	+ 95	4·36	..
Dover	„ 3	342	+ 35	35	8,119	+ 356	4·75	..
Dublin	„ 9	10,077	+ 216	..	131,053	+ 2,771	54·25	..
Dundee	„ 7	2,228	+ 32	29⅔	35,672	+ 600	15	..
East Ham	„ 10	1,890	+ 14	36⅔	37,922	+ 1,568	7.87	..
Exeter	„ 9	549	— 5	36	11,856	— 587	5·5	..
Glasgow	„ 10	34,826	+3,115	..	492,940	+28,126	97·75	3
Hastings	„ 8	1,351	+ 14	..	..	..	..	..
†Huddersfield	„ 3	1,727	+ 114	36	62,823	+ 3,468	28·5	..
Hull	„ 10	5,644	+ 282	36	99,836	+ 5,082	14·5	..
Ilkeston	„ 7	242	..	36	4,707	— 221	..	..
Ipswich	„ 10	694	+ 64	36	14,912	+ 852	10·5	..
Kilmarnock	„ 3	276	+ 18	29	4,459	+ 179	4·25	..
Lancashire United	„ 7	2,265	— 4	..	63,744	— 420	39	..
†Leeds	„ 3	6,780	+ 376	35	250,021	+ 7,692	..	..
Leicester	..	..	..	..	..	..	..	..
Leith	„ 10	1,041	+ 8	2⅔	18,394	+ 75	8·72	..
Liverpool	Nov. 26	21,133	+ 901	47½	523,379	+17,742	116	6·5
‡L.C.C.	„ 30	77,099	+3,048	..	1,460,302	+165,900	134·2	8·25
London United	Dec. 10	9,888	— 235	..	307,070	+11,771	..	..
Lowestoft	..	..	..	..	..	..	..	..
Manchester	„ 10	29,683	+ 1,609	36	560,789	+13,833	183	1
Newcastle	„ 10	7,683	..	..	143,401	+ 670	14·5	..
Newport	„ 3	1,249	+ 26	36	24,136	+ 789	14·5	..
Oldham	„ 11	3,525	+ 284	37	68,892	+ 220	23·5	..
Pontypridd	..	..	..	..	..	..	..	..
Portsmouth	„ 12	3,303	+ 70	36	76,691	— 1,649	15·25	..
Preston	„ 7	1,371	+ 47	36	26,484	— 283	..	..
Rotherham	..	..	..	..	..	..	..	..
Salford	„ 5	9,021	+ 179	35⅓	166,339	+ 3,556	..	..
Sheffield	„ 11	12,249	+ 852	..	224,111	+13,499	40	..
Southampton	„ 7	2,038	+ 153	36	39,985	+ 1,034	..	..
Southend-on-Sea	„ 7	731	+ 45	36	22,474	+ 2,495	..	..
South Shields	„ 10	972	— 66	36⅔	20,548	— 72	..	..
‡Swindon	„ 7	261	+ 16	..	5,197	+ 252	..	..
Tyneside	„ 7	643	— 94	23	9,954	+ 37	..	..
Wallasey	Nov. 26	1,752	+ 234	34·25	33,394	+ 858	..	..
†Walthamstow	Dec. 3	1,135	+ 43	35	25,489	+ 1,772	9	..
West Ham	„ 1	4,495	+ 148	35	86,979	+ 4,336	15·25	..
Wolverhampton	„ 7	1,844	+ 153	36	33,992	+ 3,618	14·25	..
Cen. London Rly.	„ 10	11,320	— 458	23	125,290	+ 3,316	6·32	..
City & S. Lon. Rly.	„ 11	7,218	+ 324	23	73,367	+ 554	7·26	..
Dublin-Lucan Rly.	„ 9	205	— 6	23	3,496	+ 165	7	..
G.N. and City Rly.	„ 10	3,100	+ 44	23	32,153	+ 965	3·5	..
L'pool Overh'd Rly.	„ 4	2,594	+ 43	..	32,558	+ 467	6·8	4·9
Llandudno-Col. Bay	Nov. 30	195	+ 33	52	14,724	+ 476	..	..
London Elec. Ry. Co.	Dec. 10	28,290	+ 875	23	286,600	+ 3,505	21·25	..
Mersey Railway	„ 10	4,170	+ 197	23	45,734	+ 616	4·5	..
†Metropolitan Rly.	„ 4	35,614	+ 759	..	372,627	+11,332	24·5	..
Met. District Rly.	„ 10	23,174	+1,387	23	245,103	+15,369	24	..
Anglo-Argentine	„ 2	99,707	+13,027	..	2,206,688	+265,507	..	..
§Auckland	Nov.	15,426	+1,495	20½	75,768	+ 8,122	23·3	1
Bombay (B.E.T.)	Dec. 11	6,428	+ 931	45	123,374	+ 9,519	..	..
§Brisbane	Nov.	18,790	+ 2,560	44	200,420	+20,428	..	..
§Brit. Columbia Rly.	..	..	..	..	..	..	..	..
Calcutta	Dec. 10	7,407	+ 465	..	..	..	..	..
§Cape Electric T.Ld.	..	..	..	..	..	..	..	..
§Kalgoorlie, W.A.	Nov.	3,385	..	..	39,037	..	20·5	..
Madras	Nov. 30	1,251	+ 11	..	30,352	+ 1,861	..	..
§Montevideo	Nov.	24,086	+2,196	..	..	..	..	..
§Lisbon	..	..	..	..	..	..	..	..
Perth (W.A.)	Dec. 2	2,935	+ 160	..	60,911	— 6,156	29	1

* Compared with the corresponding period of 1909. † One week only.
‡ Includes horse, steam and other receipts. § One month.

STOCKS AND SHARES.

Tuesday Evening.

THE disappointment felt in the Stock Exchange with regard to the result of the elections has led to politics becoming relegated to a secondary position, and the general opinion seems to be that counsels of peace will be agreed upon in the political arena until after the Coronation at all events. Surmise and speculation are, of course, directed to widely-different solutions of the present situation, but moderate views in the Stock Exchange are tending towards the direction indicated.

What is more to the immediate point is the growing cheapness of money. This has brightened up the Consol market considerably, and its influence cannot fail to percolate through to the Home Railway department, where prices had gone back because of the Unionists doing less well than was hoped in the constituencies.

Metropolitan Consolidated Stock has been up to 40 during the week, but eased off again. Districts have held their advance, and the purely electric issues are steady. East London Consolidated has again fallen upon dull days, the price sticking about 3½, while the debenture varieties are neglected.

Further outbreaks of rioting at Rio de Janeiro are the cause of Rio trams being depressed at 104½. The first mortgage bonds keep very steady at 100¼, while the seconds at 92 have slightly relaxed. Sao Paulo Trams are quiet at 156, and other properties in this list are steady.

Edinburgh and Glasgow, as well as several of the Northern cities in England, are largely interested in the Latin-Canadian group, and the opportunity was taken during a recent provincial tour to seek expert opinion on the subject of these securities. Amongst those canvassed was a member of a leading firm of provincial stockbrokers, who had lately returned from an American trip that began in British Columbia and ended in Mexico. The remarkable part of the interviews was the unanimity of favour with which the companies were mentioned. In London there does exist, here and there, a kind of half suspicion about the solidarity of the group as a whole, and although it appears in a sort of shamefaced way, there the distrust certainly is. But the two chief Scottish cities are confident enough, and leading financial houses in the North hold very large stakes in the prior-charge bonds. Perhaps if the truth were known, they are not without interest in the junior securities, but that, of course, is a matter hidden from merely prying eyes.

Amongst the lower-priced bonds in the Latin-Canadian division may be instanced the 5 per cent. issue of the Pachuca Light and Power, standing at ½ premium. The scrip, which will be fully paid up this week (£88 10s.), carries a six months' interest payable next April. Principal and interest are guaranteed by the Mexican Light and Power Company.

The proposals of the London County Council to spend nearly a couple of million pounds sterling in fresh tramway development in London are not calculated to rejoice the hearts of stockholders in other tramway enterprises; nor, for the matter of that, in omnibus or tube companies either. Fourteen miles of new tramways might make a considerable difference to the existing means of transportation. None of the stocks and shares in the latter companies, however, have been affected so far by the new scheme. Metropolitan Electric Tramways Ordinary and Preference are both better on the week. The Deferred shares of the company are about a florin apiece, and although it is outside the province of these Notes to even suggest gambling, the exception shall prove the rule, and, simply as a speculation, these fully-paid one pound shares, bought to put away, might one day show a profit handsome enough to compensate for the dividends which they are likely to lack for a long while yet.

British Columbia Electric Railway Preference and Debenture stocks are moving up, and British Electric Traction Ordinary, at £1, show 1/16 rise for the second week in succession. On the other hand, the B.E.T. Second Debenture stock shed its point improvement, and the market is still a rather "wobbly" one. Anglo-Argentine Tramways First Preference at 4 15/16 are quoted slightly easier; there is a good deal of steady investment being done in them, but the advance to par brought in a few sellers at that figure.

There is not much more than usual doing in the electricity supply market. St. James' and Pall Mall Ordinary fell ⅛, but Metropolitan Ordinary gained a like fraction. The latter company has seized the occasion to advertise its radiators, &c., as novel and useful Christmas gifts. A small local demand for Hove shares assisted the price. The Mexican Light and Power issues have improved.

Renewed excitement over Anglo-American Telegraphs has given the prices of the trio of stocks a useful hoist. Dividend anticipations are the latest levers employed in raising the Deferred stock, and next February's announcement is being liberally discounted. But the agreement with the American Telephone and Telegraph Company is the principal stick in use to beat the bears with. Eastern Extension shares continue to creep up quietly. Mackay Common dropped several points. National Telephones are quiet. Marconis fell to 15s.

The miscellaneous market keeps steady as a whole, but a few declines have occurred. Babcock went back ⅛, and Castner-Kellners, after their good advance, reacted 1/16. The India-Rubber and Telegraph Works Company reports a net profit of £55,400 for the year—a decline of £2,500. This does not affect the usual dividend of 10 per cent., and a special reserve of £30,000 has been created against possible depreciation of selling prices. The shares of the Telegraph Construction Co. at 38 are 10s. higher. Henley's are ¼ to the good, and there has been some demand for the company's Debenture stock.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1906.	1907.	1908.	1909.	Closing Quotations Dec. 6th.	Closing Quotations Dec. 13th.	Business done week ended Dec. 13th, 1910. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	Nil	5⅛— 6	5⅛— 6	5⅝	..	..	Nil.
286,500	Do. 5 % Deb. Red. Iss. at 98 % script all paid	Stock	5 %	5 %	5 %	5 %	96 — 98	97 — 99	98	..	+1	5 1 0
$255,196,000	American Telephone & Telegraph, Cap Stock ..	$100	8 %	8 %	8 %	8 %	143 —146	144 —146	..	..	+ ½	5 9 7
$53,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 53,001 to 78,000	$1000	4 %	4 %	4 %	4 %	94½— 96⅞	95 — 97	97	96⅞	+ ⅛	4 2 6
558,460	Anglo-American Telegraph	Stock	3⅞%	3⅞%	£3 4s.	3⅞%	68 — 70	69½— 71½	70	..	+1½	5 2 1
3,220,770	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	6 %	110 —112	112 —114	113½	110½	+2	5 5 3
3,220,770	Do. do. do. Deferred	Stock	1¾%	1 %	8/-	25/-	27⅞— 28½	29½— 29⅞	29 1/16	27⅞	+1½	4 4 0
47,725	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	5 %	5 %	5 %	5 %	102 —104	102 —104	..	..	..	4 16 2
44,000	Chili Telephone, Nos. 1 to 44,000	5	8 %	8 %	8 %	8 %	7 — 7¼	7 — 7¼	7⅛	6 7/16	..	5 10 4
2,449,176	Commercial Cable, Sting. 500 year 4% Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	85 — 87	85 — 87	86	85½	..	4 12 0
16,000	Cuba Telegraph	10	5 %	6 %	6 %	6 %	8½— 9½	8⅛— 9½	8 3/16	..	..	6 9 9
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	10 %	16⅝— 17⅞	16⅝— 17⅞	..	..	..	5 15 11
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3⅜— 3¾	3⅜— 3¾	..	..	..	5 1 7
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8½— 8⅝	8½— 8⅝	..	..	..	5 14 3
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	101 —103	101 —103	..	..	..	4 7 5
60,710‡	Direct United States Cable	20	4⅝%	4½%	4⅝%	4 %	15⅝— 16⅛	15⅝— 16⅛	16⅛	16 1/16	— ⅛	4 19 3
	Direct W. India Cable, 4½% Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	100½—102½	101 —103	..	..	+ ½	4 7 5
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	135 —138	135 —138	137	135½	..	5 1 5
2,000,000	Do. 8½ % Pref. Stock	100	8½%	8½%	8½%	8½%	83 — 85	83 — 85	..	..	..	4 2 4
1,896,706	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	99½—101½	99½—101½	..	..	..	3 18 10
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	12⅝— 13½	12⅝— 13½	13⅛	12⅝	+ ⅛	5 7 8
752,400	Do. 4 % Deb. Stock..	Stock	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..	3 18 5
200,000‡	East. & S. Afric. Tel., 4 % Mt. Db. Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	99 —101	99½—101½	..	..	+ ½	3 18 10
181,127	Globe Telegraph and Trust	10	5⅛%	5⅞%	5⅜%	5⅞%	10⅛— 10⅜	10⅛— 10⅜	10⅜	10 3/16	..	5 9 5
181,127	Do. do. 6 % Pref...	10	6 %	6 %	6 %	6 %	13⅛— 13⅜	13⅛— 13⅜	13⅜	13 3/16	..	4 7 3
150,000	Great Northern Telegraph, of Copenhagen.. ..	10	20 %	20 %	18 %	18 %	30½— 31½	30½— 31½	31½	30¼	..	5 14 9
17,000	Indo-European Telegraph	25	13 %	13 %	13 %	13 %	53 — 55	53 — 55	54½	53½	..	5 18 7
$41,380,400	Mackay Companies Common	$100	3½%	4 %	4 %	4½%	95 — 98	90 — 95	..	..	— 4	4 9 6
$50,000,000	Do. do. 4% Cum. Pref.	$100	4 %	4 %	4 %	4 %	75 — 80	75 — 80	..	..	..	5 0 0
394,190	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	⅜— ⅞	11/16— 13/16	..	..	—1/16	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	6 %	6 %	6 %	6 %	⅞— 1	⅞— 1	..	..	..	6 0 0
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	5 %	31/32— 15/16	31/32— 15/16	16/-	..	—1/32	5 11 1
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	105⅝—106⅜	106 —107	106¼	106	+ ¼	5 12 2
3,725,000	Do. do. Def. Stock	100	5 %	6 %	6 %	6 %	128 —130	128 —130	129½	128½	..	4 12 4
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	10⅛— 10⅜	10⅛— 10⅜	..	..	..	5 10 4
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10⅛— 10⅜	10⅛— 10⅜	..	..	..	5 10 4
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅛— 5 1/16	5⅛— 5 1/16	5 1/16	..	..	4 10 0
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	99 —101	99 —101	99½	..	..	3 9 4
1,983,593	Do. do. 4 % Deb. Stock Red... ..	100	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..	3 19 3
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid..	1	7 %	8 %	8 %	8 %	1⅛— 1 3/16	1⅛— 1 3/16	..	..	..	4 14 10
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1⅛— 1 3/16	1⅛— 1 3/16	..	..	..	4 7 3
195,955	Do. do. do. 4 % Red. Deb. Stock..	100	4 %	4 %	4 %	4 %	88 — 90	88½— 90½	89½	89	+ ½	4 8 5
99,400	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..	3 19 7
11,889	Reuter's	8	5 %	5 %	5 %	5 %	7½— 8	7½— 8	..	..	..	5 0 0
145,955	Telephone Co. of Egypt, 4½ % Deb. Red.	100	4½%	4½%	4½%	4½%	98 —100	98 —100	..	..	..	4 9 7
3,042	Submarine Cables Trust..	Cert.	6 %	6 %	6 %	6 %	131 —134	132 —135	..	..	+ 1	4 8 11
120,000	United River Plate Telephone	5	8 %	8 %	8 %	8 %	7⅞— 7⅞	7⅞— 7⅞	7 7/16	7⅞	..	5 6 8
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5⅜— 5⅝	5⅜— 5⅝	5 1/16	..	+ ⅛	4 6 11
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2½	2½%	2½%	2½%	2½%	1 1/16— 1 1/8	1 1/16— 1 1/8	25/-	..	..	4 12 8
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..	3 19 3
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	7 %	13⅜— 13¾	13⅜— 13⅝	13⅝	13⅜	..	5 4 5
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	101 —103	101 —103	102	101½	..	3 17 8
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	1⅛— 1 1/16 xd	1⅛— 1 1/16	27/6	26/9	..	Nil
34,563	Do. do. 6 % Cum. 1st Pref.	10	8 %	6 %	6 %	6 %	9⅛— 9¼ xd	9⅛— 9½	9½	..	..	6 4 8
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	£2 6	15 %	14½%	8⅞— 9½	8⅞— 9¼	9	..	..	6 9 9
80,000‡	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	102 —104	102 —104	..	..	..	4 16 2

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

640,000	Anglo-Argentine Trams, 5% Cum. 1st Pref. 1 to 640,000	5	..	..	..	5 %	4⅞— 5⅛	4 13/16— 5 1/16	101/10½	97/6	—⅛	4 18 9
500,000	Do. 5 % 2nd Pref., 800,000 to 1,300,000	5	..	..	..	5 %	4¼ — 4⅜	4¼ — 4⅜	91/10½	88/9	..	5 5 3
4,465,674	Do. 4 % Deb. Stock	Stock	..	..	4 %	4 %	92 — 93½	92 — 93½	93	92½	..	4 5 7
392,387	Auckland E. Trams, 5 % 1st Mort Deb. Stock ..	100	5 %	5 %	5 %	5 %	103 —105	103 —105	..	..	..	4 15 3
890,000	Babcock & Wilcox, 1 to 530,000	1	20 %	20 %	20 %	24 %	5⅝— 5⅞	5⅝— 5⅞	5⅞	..	..	4 2 7
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1⅜— 1½	1⅜— 1½	..	..	..	4 0 0
1,000,000	British Aluminium 5 % Mort. Debs. Red.	100	..	..	..	..	..	..	..	..	..	5 9 7
500,000	British Columbia E. Rail Def. Ord. Stock	100	6 %	8 %	8 %	8 %	146 —150	146 —150	147½	..	..	5 6 8
400,000	Do. Pref. Ord. Stock	100	5 %	5 %	6 %	6 %	123 —127	123 —127	126	124½	..	4 14 6
400,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	110 —113	110½—113½	112⅝	111½	+ ½	4 8 1
233,000	Do. 4½ % 1st Mort. Deb., 1 to 6,250	40	4½%	4½%	4½%	4½%	100 —102	102 —104	103½	..	+2	4 6 7
212,600	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	100 —103	102 —105	..	..	+2	4 5 9
133,301	British Electric Traction	10	Nil	Nil	Nil	Nil	1⅛— 1 1/16	1⅛— 1¼	22/6	20/-	+ 1/16	Nil
161,437	Do. do. 6 % Cum. Pref.	10	6 %	3 %	1¼%	Nil	3⅜— 3 1/16	3⅜— 3 1/16	73/9	..	..	Nil
1,473,653	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	89 — 93	89 — 93	90½	89	..	5 7
528,936	Do. do. 4½ % 2nd Deb. Stock Red.	100	4½%	4½%	4½%	4½%	75 — 80	74 — 79	7⅛	7 1/16	+1	5 12 6
100,000	British Insulated and Helsby Cables	5	10 %	10 %	10 %	10 %	6⅜— 7¼	6⅜— 7¼	..	..	..	6 17 11
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅜— 6	5⅜— 6	..	..	..	5 0 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red...	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
201,579‡	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 75,000	5	Nil	Nil	Nil	Nil	1/16— 2/16	½ — ⅝	6/3	5/6	—1/16	Nil
1,316,353	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	59 — 62	59 — 62	..	..	..	6 9 1
50,000	‡Browett, Lindley & Co., Ord.	1	Nil	Nil	Nil	Nil	⅝— ¾	⅝— ¾	..	..	..	Nil
50,000	Do. do. 6 % Cum. Pref.	1	Nil	Nil	Nil	Nil	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
140,976	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	Nil	0 — ⅛	0 — ⅛	..	..	..	Nil
200,000	Do. do. Non-cum. 6 % Pref... ..	2	Nil	Nil	Nil	Nil	0 — ⅛	0 — ⅛	..	..	..	Nil
125,000‡	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	37 — 42	37 — 42	..	..	..	10 14 4
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock..	Stock	4½%	4½%	4½%	4½%	23 — 27	23 — 27	..	..	..	18 19 3
137,610	Calcutta Trams, 1 to 137,610	5	8 %	6 %	4½%	4½%	4¾— 5	4¾— 5	..	..	..	4 10 0
45,304	Do. 5 % Cum. Pref., Nos. 1 to 29,330..	5	5 %	5 %	5 %	5 %	4⅝— 5⅛	4⅝— 5¼	..	..	..	4 17 7
350,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	98 —101	99 —101	..	..	..	4 9 1
35,000	Callender's Cable Construction shares	5	15 %	15 %	15 %	10 %	9⅛— 9⅜	9⅛— 9⅜	..	..	..	5 3 3
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	4 13/16— 5 1/16	4 13/16— 5 1/16	..	..	..	4 5 9
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	104 —106	104 —106	..	..	..	4 4 11
491,222	Cape E. Trams., 1 to 491,222	1	Nil	Nil	Nil	Nil	1/16— 2/16	1/16— 2/16	11/-	10/8	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	8 %	12 %	12½%	17½%	3 1/16— 3 1/8 xd	⅛ — 3 1/16	62/6	61/3	+ 1/16	5 8 2
210,153	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4 %	4½%	105 —108	105 —108	..	..	..	4 3 4
1,890,690	Central London Railway, Ord. Stock	Stock	4 %	3 %	3½%	3 %	63 — 65	63 — 66	65	63½	..	4 12 4
554,655	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	85 — 87	85 — 87	..	..	..	4 12 0
554,655	Do. do. Def. do.	Stock	4 %	2 %	2½%	2 %	44 — 46	44 — 46	..	..	..	4 7 0
1,480,000	City and South London Railway	Stock	2¾%	2¾%	1½%	1⅜%	26½— 27½	26⅝— 27⅝	27½	27	..	6 7 3
85,000	Crompton & Co., Nos. 1 to 85,000	8	5 %	5 %	Nil	Nil	¼ — ⅜	¼ — ⅜	..	..	..	Nil
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 900 of £100, and 901 11,000 of £50 Red	..	5 %	5 %	5 %	5 %	83 — 86	83 — 86	..	..	..	5 17 8

* Unless otherwise stated, all shares are fully paid. ‡ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued.*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1906.	1907.	1908.	1909.	Closing Quotations Dec. 6th.	Closing Quotations Dec. 13th.	Business done week ended Dec. 13th, 1910. Highest	Lowest	Rise + or Fall —	Present Yield per cent. £ s. d.
260,000	Dick, Kerr & Co., 1 to 260,000	1	10 %	10 %	6 %	5 %	¼ — 1	¼ — 1	..	..	..	5 0 0
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	6 %	1 5/16 — 1 7/16	1 5/16 — 1 7/16	..	..	..	5 7 10
271,080	Do. do. 4½ % Deb. Stock	100	4½ %	4½ %	4½ %	4½ %	98 —101	98 —101	..	..	..	4 9 1
60,000	Dublin United Trams. (1896), 6 % Pref., 1 to 60,000	10	6 %	6 %	6 %	6 %	12½ — 13½	12½ — 13½	..	..	..	4 8 11
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	5	2½ %	2½ %	Nil	Nil	0 — ⅛	0 — ⅛	..	..	..	Nil
17,189	Do. "A" shares, 01—017,189	5	2½ %	2½ %	Nil	Nil	1 — 1¼	1 — 1¼	..	..	..	Nil
307,895	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	63 — 68	63 — 68	..	..	..	5 17 8
67,720	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	77 — 80	77 — 80	..	..	..	6 5 0
112,100	Electric Construction, 1 to 112,100	2	Nil	Nil	Nil	Nil	⅜ — ⅝	⅜ — ⅝	..	..	..	Nil
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	7 %	1⅝ — 1¾	1⅝ — 1¾	..	..	..	7 9 4
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	5 %	8⅛ — 8⅝	8⅛ — 8⅝	..	..	..	5 15 7
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	80 — 84	80 — 84	83½	..	..	4 15 3
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	4 %	½ %	Nil	Nil	¾ — 1	¾ — 1	..	..	..	Nil
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	7 %	10¼ — 10⅜	10¼ — 10⅜	..	..	..	6 10 3
80,000	Do. do. 5 % Mort. Debs.	10	5 %	5 %	5 %	5 %	102 —103⅛	102 —103⅛	..	..	..	4 16 10
40,000	Henley's (W.T.), Telegraph Works, Ord.	5	15 %	15 %	15 %	15 %	12¼ — 12⅝	12½ — 13	12 1/16	..	+ ¼	5 15 5
40,000	Do. do. 4½ % Pref.	5	4½ %	4½ %	4½ %	4½ %	5 1/16 — 5 3/16	5 1/16 — 5 5/16	5⅛	..	..	5 4 8
150,000	Do. do. 4½ % Mort. Deb Stock	Stock	4½ %	4½ %	4½ %	4½ %	106 —108 xd	107 —109	106½	..	..	4 3 4
50,000	India-Rubber, Gutta-percha & Telegraph Works	10	10 %	10 %	10 %	10 %	15½ — 16	15½ — 16½	..	..	+ ½	6 3 1
37,500	†Liverpool Overhead Railway, Ord.	10	Nil	½ %	Nil	Nil	1 1/16 — 1 3/16	1 1/16 — 1 1/16	..	..	..	Nil
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	6½ — 7½	6½ — 7½	..	..	..	6 15 7
600,070	London United Trams. (1901) 1 to 50,007	10	3 %	3 %	Nil	..	1⅜ — 2⅛	1⅜ — 2⅛	..	..	..	Nil
399,930	Do. do. 60,008 to 100,000	10	3 %	3 %	Nil	..	1⅜ — 2⅛	1⅜ — 2⅛	..	..	..	Nil
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	3⅜ %	Nil	1⅜ — 2⅛	1⅜ — 2⅛	40/-	36/3	..	..
1,649,930	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	67 — 71	67 — 71	..	..	..	5 12 8
5,782,062	Metropolitan Consolidated	100	1 %	⅛ %	⅛ %	1 %	39½ — 40	39⅝ — 40	40	39⅝	..	2 10 0
2,640,914	Do. Surplus Lands	100	2⅜ %	2⅜ %	2⅜ %	2⅜ %	64 — 66	64 — 66	64½	..	..	4 3 4
3,235,000	Do. District	100	Nil	Nil	Nil	Nil	26 — 26½	26 — 26½	2 2	25⅝	..	Nil
391,337	Metropolitan Electric Trams., Ord.	1	..	..	4½ %	5%	3/16 — 13/16	3/16 — 13/16	16/6	16/-	+ 1/16	5 14 3
314,016	Do. do. Defd.	1	Nil	Nil	Nil	..	1/16 — 3/16	1/16 — 3/16	1/3	..	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	29/32 — 15/16	29/32 — 15/16	17/6	16/9	+ 1/32	5 6 8
595,600	Do. do. 4½ % Deb. Stock Red.	100	4½ %	4½ %	4½ %	4½ %	98 —101	98 —101	100	98½	..	4 9 1
$10,823,200	Mexico Trams Co., Common Stock	..	..	..	..	6 %	123 —125	122 —124	122⅜	..	—1	4 16 9
$9,000,000	Do. 1st Mort. 50-year 5 % Gld. Bds.	..	..	..	5 %	5 %	96 — 98	96½ — 97½	97½	96½	— ½	5 2 10
245,500	Potteries Electric Traction	1	4 %	4 %	Nil	..	3/16 — 5/16	3/16 — 5/16	3/9	..	..	..
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	3/8 — 5/8	3/8 — 5/8	10/9	..	..	7 5 5
245,000	Do. 4½ % Deb. Stock	100	4½ %	4½ %	4½ %	4½ %	80 — 83	80 — 83	..	..	..	5 8 5
37,350	Telegraph Construction and Maintenance	12	15 %	17½ %	15 %	17½ %	36½ — 38½	37 — 39	38½	33	+ ½	5 9 4
140,000	Do. 4 % Deb. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	101 — 103	101 —103	..	..	..	3 17 8
1,000,000	Underground Electric Railway, 5 % Prior Lien	..	..	..	5 %	..	100 —101	100½ —101½	100⅞	..	+ ½	4 18 6
2,800,000	Do. do. 4½ % Bonds	..	..	..	4½ %	4½ %	94 — 96	94 — 96	..	..	..	4 13 9
4,900,000	Do. do. 6 % Income Bonds	..	..	..	..	..	38 — 40	38 — 40	..	38	..	..
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	1	Nil	10 %	5 %	Nil	⅛ — ¼	⅛ — ¼	..	..	..	..
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	..	6 %	6 %	3 %	1 — 1½	1 — 1½	..	..	..	10 0 0
245,495	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	55 — 65	55 — 65	..	..	..	6 3 1

ELECTRICITY SUPPLY COMPANIES.

30,449	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10%	10 %	10 %	10 %	6⅞ — 7⅛	6⅞ — 7⅛	..	..	..	6 15 7
9,551	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	6¾ — 7⅛	6¾ — 7⅛	..	..	..	4 14 11
400,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	99 —102 xd	99 —102	..	..	..	3 18 5
80,000	Charing Cross and Strand Electricity Supply	5	5 %	5 %	5 %	5 %	3⅝ — 4⅛	3⅝ — 4⅛	..	..	..	5 19 5
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½ %	4½ %	4½ %	4½ %	4⅛ — 4⅜	4⅛ — 4⅜	87/6	..	..	4 17 4
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½ %	4½ %	4½ %	4½ %	3⅞ — 4¼	3⅞ — 4¼	..	..	..	5 5 11
415,736	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	97 — 99	97 — 99	..	..	..	4 2 6
9,436	Chelsea Electricity Supply, Ord.	5	4½ %	4½ %	4½ %	4½ %	3½ — 3¾	3½ — 3¾	..	..	..	6 0 0
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½ %	4½ %	4½ %	4½ %	99 —101	99 —101	..	..	..	4 9 1
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	6 %	6 %	6 %	7 %	11 — 11½	11 — 11½	11 5/16	11½	..	6 1 9
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11¾ — 12¼	11¾ — 12¼	12 1/16	11 13/16	..	4 19 0
400,000	Do. 5 % Db. Stk.	Stock	5 %	5 %	5 %	5 %	120 —124	120 —124	..	..	..	4 0 8
800,000	Do. 4½ % 2nd. Db. Stk.	100	4½ %	4½ %	4½ %	4½ %	99½ —102½	99½ —102½	..	..	..	4 7 10
50,000	County of Durham Electrical Power, Ord.	5	4 %	2 %	Nil	Nil	1¾ — 2	1¾ — 2	..	..	..	Nil
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	2⅝ — 3⅛	2⅝ — 3⅛	..	..	..	7 16 10
200,000	Do. do. do. 5 % 1st Mtg. Deb.	Stock	..	..	5 %	5 %	94½ — 96½	94½ — 96½	..	..	..	5 3 8
40,000	County of London Electric Lighting, Ord. 1—40,000	10	5 %	5 %	5 %	5 %	7⅝ — 7⅞	7⅝ — 7⅞	..	..	..	6 7 0
55,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10¾ — 11	10¾ — 11	10 9/16	10⅝	..	5 9 1
400,000	Do. do. 4½ % Deb. Stock	Stock	4½ %	4½ %	4½ %	4½ %	104½ —107½	104½ —107½	..	..	..	4 3 9
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½ %	4½ %	4½ %	4½ %	98 —101	98 —101	..	..	..	4 9 1
80,000	Edmundson's Electric Corporation, Ord. Shares	5	Nil	Nil	Nil	Nil	⅝ — ¾	⅝ — ¾	6/3	..	..	Nil
80,000	Do. do. 6 % Cum. Pref.	5	3 %	Nil	Nil	Nil	1¾ — 2	1¾ — 2	35/-	..	..	Nil
420,500	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½ %	4½ %	4½ %	4½ %	75 — 78	74 — 77	..	..	—1	5 16 11
$8,150,000	Electrical Dev. Co. of Ontario, 5% 1st Mtg. Gold Bnds.	$500	..	..	5 %	5 %	81½ — 84½	81½ — 84½	81¼	81½	..	5 18 4
10,000	Folkestone, 1 to 10,000	5	5½ %	5½ %	5½ %	5½ %	4⅜ — 4⅝	4⅜ — 4⅝	..	..	..	5 12 10
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	5 %	5 %	5 %	5 %	4½ — 5⅛	4⅝ — 5⅛	..	..	..	4 11 11
90,000	Do. 4½ % 1st Deb. Stock	100	4½ %	4½ %	4½ %	4½ %	99 —102	99 —102	..	..	..	4 8 3
15,000	Hove, 1 to 15,000	5	9 %	8¼ %	8¼ %	8½ %	6¾ — 7	6⅞ — 7⅛	..	..	+ ⅛	5 19 4
$1,376,000	Kaministiquia Power Co., 5 % Gold Bnds.	100	..	..	5 %	5 %	10 ⅛ —105½	103½ —105½	..	..	..	4 14 9
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	10 %	8 %	8 %	6½ — 7	6½ — 7	..	..	..	5 14 3
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	93 — 95	93 — 95	..	..	..	4 4 3
11,000	London Electric Supply Corporation, Limited, Ord.	3	4 %	2½ %	3 %	..	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..	5 2 2
70,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	..	4½ — 5⅛	4⅝ — 5⅛	..	..	..	5 17 1
382,355	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4½ %	4½ %	4 %	4 %	90 — 93	90 — 93	..	..	..	4 6 0
200,000	Metropolitan Electric Supply, 1 to 100,000	5	8 %	6½ %	5 %	5 %	3⅜ — 3⅝	3⅜ — 3⅝	72/6	66/3	+ ⅛	6 13 4
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½ %	4½ %	4½ %	4½ %	4⅛ — 4⅜	4⅛ — 4⅜	..	..	..	4 17 4
285,000	Do. 4½ % 1st Mort. Deben. Stock	Stock	4½ %	4½ %	4½ %	4½ %	102 —105	102 —105	..	..	..	4 5 9
248,000	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½ %	3½ %	3½ %	3½ %	82 — 85	82 — 85	..	..	..	4 2 4
$6,000,000	Mexican Electric Light Co., 5% 1st Mtg. Gold Bnds	100	5 %	5 %	5 %	5 %	88 — 89	87⅞ — 88⅞	88⅜	87⅞	— ⅛	5 12 8
13,585,000	Do. Light and Power Co., Ltd., Common	$100	..	4 %	3½ %	4 %	87½ — 89½	88⅜ — 90½	89⅛	88⅜	+1	4 8 5
$2,400,000	Do. do. 7% Cum. Pref. Stk.	Stock	..	..	7 %	7 %	104 —106	104⅛ —106⅛	105⅜	105	+ ⅛	6 11 5
12,000,000	Do. do. 5% 1st Mtg. Gold Bnds.	100	..	..	5 %	5 %	91⅞ — 92⅜	92 — 93	92⅜	92¼	+ ¼	5 7 6
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½ %	4 %	4½ %	4½ %	97 — 99	97 — 99	..	..	..	4 10 11
130,491	Newcastle-on-Tyne, 1 to 137,500	5	8 %	8 %	2½ %	..	3⅜ — 4¼	3⅜ — 4¼	..	..	..	2 12 9
137,500	Do. 5 % Pref., 1 to 137,500	5	5 %	5 %	5 %	5 %	4⅜ — 4⅝	4⅜ — 4⅝	..	..	..	5 2 7
150,000	North Metropolitan Electric Power Supply Co., 5 % Mortgages (Red.), Nos. 1 to 1,500	100	..	..	..	5 %	97½ — 99½	97⅝ — 99½	..	..	..	5 0 6
10,852	Notting Hill Electric Lighting	10	7½ %	7½ %	7 %	..	12 — 13	11½ — 12½	13	..	— ½	5 12 0
20,000	Oxford, 1 to 96 and 407 to 20,310	5	7 %	7 %	7 %	7 %	6¼ — 6¾	6¼ — 6¾	6½	..	..	5 8 8
119,694	River Plate Elcty. Co. Ord.	Stock	2½ %	6 %	8 %	9 %	228 —238	228 —238	235	232½	..	3 15 8
100,000	Do. do. 6% Non Cum. Pref.	Stock	6 %	6 %	6 %	6 %	100 —110	100 —110	107½	..	..	5 9 1
200,000	Do. do. 5% Deb. Stk. Red.	100	5 %	5 %	5 %	5 %	100½ —102½	100½ —102½	..	..	..	4 17 7
40,000	St. James' and Pall Mall Electric Light, Ord.	5	10 %	10 %	10 %	10 %	7⅞ — 8	7⅞ — 7¾	7¾	7⅞	— ⅛	6 7 0
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	6¾ — 7⅛	6¾ — 7⅛	..	..	..	4 14 1
150,000	Do. do. 3½ % Deb. Stock Red.	100	3½ %	3½ %	3½ %	3½ %	86 — 88	86 — 88	..	..	..	3 19 7
12,000	Smithfield Markets Electric Supply, Ord.	5	Nil	Nil	Nil	..	1⅝ — 2	1⅝ — 2	..	..	..	Nil
65,000	South London Electric Supply, Ord.	4	3 %	4 %	5 %	5 %	2⅝ — 3	2⅝ — 3	..	..	..	6 13 4
130,100	Do. do. 5 % 1st Mort. Deb.	100	..	..	5 %	5 %	100 —103	100 —103	..	..	..	4 17 1
120,000	South Met. Elec. Lt. & Power, Ord.	1	2½ %	2½ %	2½ %	..	3/32 — 5/32	3/32 — 5/32	..	..	..	Nil
142,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1 7/32 — 1 9/32	1 7/32 — 1 9/32	..	..	..	6 16 7
224,520	Do. do. 4½ % 1st Deb. Stk.	100	4½ %	4½ %	4½ %	4½ %	96 — 99	96 — 99	..	..	..	4 10 11
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	..	½ — 1	½ — 1	..	..	..	20 0 0
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	2 — 2½	2 — 2½	..	..	..	10 0 0
275,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	4½ %	4½ %	4½ %	4½ %	82 — 84	82 — 84	..	..	+2	5 7 2
808,000	Victoria Falls Power Co., Pref. Nos. 1 to 808,000	1	..	..	5 %	..	⅜ — ⅝	⅜ — ⅞	..	..	..	5 14 3
100,000	Westminster Electric Supply, Ord.	5	12 %	10 %	10 %	10 %	7⅛ — 8	7⅛ — 8	7 1/16	..	..	6 5 0
51,279	Do. do. 4½ % Cum. Pref. (Reduced from 5% since 31st Dec., 1905)	5	4½ %	4½ %	4½ %	4½ %	5 — 5½	5 — 5½	..	..	..	4 1 10

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange.

Bank rate of Discount 4½ per cent. December 1st. 1910.

THE LEGAL EFFECT OF SPECIFICATIONS.

[BY OUR LEGAL CONTRIBUTOR.]

In a recent number of the Review (October 7th, page 592) the question of uniformity in specifications was dealt with at some length. It was pointed out that to tender without closely examining a specification was a dangerous experiment; but the real danger only becomes manifest when it is realised that the specifications ultimately become part of the contract. As a corollary to the former article the following notes on the subject may be of interest.

As a general rule the engineer tries to protect himself and his employer as far as possible from errors in specifications. To this end he frequently inserts a stipulation that the contractor shall satisfy himself as to the dimensions, levels and nature of all existing works and other things connected with the contract works; that the employer does not hold himself responsible for the accuracy of the information as to the sections or foundations of existing walls and works; and that no charges for extra work or otherwise will be allowed in consequence of incorrect information or inaccuracies in the drawings or specifications.

Again, a common form of contract (applicable more especially to the building trade) provides that the builder shall be accountable "for the full performance of this contract, and by signing hereof, admits that the said plans, elevations, sections and specifications, descriptions and particulars before referred to, are sufficient for their intended purpose, and that without any additional or extra work, other than the works set forth thereby, or necessarily inferred to be done from the general nature and tendency of the plans and descriptions aforesaid."

Further, in order to protect himself against any error in the bills of quantities, the employer frequently insists upon the insertion of a clause to the following effect:—

"The bill of quantities on which the tender of the contractor is based was prepared for the purpose of assisting persons tendering for the works in making their calculations, but it does not profess to give actual cube measurements or to be otherwise than approximate in the figures therein stated, and the employer will not be responsible for the accuracy of such quantities, and the builder is not to be entitled to any claim for extras based on any alleged error therein, but is responsible for the completion of the entire works, as described in the plans and specifications, at the contract price."

A notable example of the way in which a contractor may be put to loss and expense owing to implicit reliance on the measurements, &c., of the employers' engineer, is furnished by the well-known case of Thorn *v.* Mayor of London (1876), L.R., I.A.C. 120. There the Corporation of London invited contractors to tender for the execution of certain works for the building of Blackfriars Bridge according to plans and specifications prepared by the engineer to the Corporation. The specification provided that the contractors were to take out their own quantities, and that the accuracy of the plans was not guaranteed by the Corporation. The contractors were warned particularly that they must satisfy themselves as to the nature of the ground through which the foundations had to be carried. Iron caissons were specified to be used in the construction of the works, but when the contractors whose tender was accepted proceeded to use the caissons as designed, it was found that they would not resist the pressure of the water, and the plan of the work had to be altered and the use of the caissons abandoned. The contractors claimed for the loss occasioned to them in attempting to use caissons according to the specification. The House of Lords held that no warranty could be implied. The following passage from the judgment of Lord Chelmsford has become historic. He said: "There can be no doubt that the plaintiff, in the exercise of common prudence, before he made his tender, ought to have informed himself of all the particulars connected with the work, and especially as to the practicability of executing every part of the work contained in the specification according to the specified terms and conditions. It is said that it would be very inconvenient to require an intended contractor to make himself thoroughly acquainted with the specification, as it would be necessary upon each occasion for him to have an engineer by his side. . . . But if the contractor ought prudently and properly to have full information of the nature of the work he is preparing to undertake, and the advice of a skilful person is necessary to enable him to understand the specification, is it any reason for not employing such a person that it would add to the expense of the contractor before making his tender? It is also said that it is the usage of contractors to rely on the specification and not to examine it particularly for themselves; if so, it is a usage of blind confidence of the most unreasonable description."

While Thorn *v.* Mayor of London may by regarded as a leading authority, the facts capable of proof in another case may not tally with it. In Pearson *v.* Dublin Corporation (1907, A.C., 357) it was laid down that if the specification or the plans contain or involve statements of fact which are false to the knowledge of the employer, the question of fraud enters into the matter, and the contractor may be in a position to claim relief. In this connection it should be mentioned that a statement made by a person recklessly, and without caring whether it be true or false, is deemed fraudulent in the eye of the law. In that case there was a contract to execute certain sewerage works. The plaintiffs covenanted to do the works described in the drawings, specifications, &c., and the defendants covenanted to pay for the works on receipt of the certificate in writing of their engineer as provided by the conditions. The specification provided, *inter alia*, that the plaintiffs must verify all representations, and not rely upon their accuracy. The works in question involved the transformation of an old harbour in the Liffey into a sewerage tank. On completion, the plaintiffs claimed £36,574 from the defendants on the grounds—first, that the plans showed a certain existing wall extending some 9 ft. below the ordnance datum line, which could be utilised for the purposes of the works; that this wall did not exist, and that consequently the plans for the works had been altered, and the plaintiffs, at the direction of the engineer, had completed the works at this extra cost; secondly, that the defendants had fraudulently misrepresented the structure and existence of this wall, and had thereby induced the plaintiffs to enter into a contract to their detriment. The defendants relied on the absence of a certificate from their engineer and on the conditions of the specification, and they denied the making of any representation and any fraud.

It was held that the specification only protected the defendants in respect of honest mistakes by themselves or their agents, and that it was for a jury to say whether there was fraud or not. In giving judgment, the Lord Chancellor pointed out that evidence was adduced at the trial from which the jury might, if they thought right, conclude that the plaintiffs were induced to enter into the contract by statements made on behalf of the defendants. There was also evidence for the jury that those statements were made with a knowledge of their falsity, or (which was the same thing) with a reckless indifference whether they were false or true, on the part of the engineers employed by the defendants to make the plans which were submitted as the basis of the tender. Having referred to the clauses which pointed out that the plaintiffs were not to rely on the plans, he said, "Now it seems clear that no one can escape liability for his own fraudulent statements by inserting in a contract a clause that the other party shall not rely on them. I will not say that a man, himself innocent, may not under any circumstances, however peculiar, guard himself by apt and express clauses from liability for the fraud of his own agents. It suffices to say that, in my opinion, the clauses before us do not admit of such a construction. They contemplate honesty on both sides and protect only against honest mistakes. The principal and the agent are one, and it does not signify which of them made the incri minated statement or which of them possessed the guilty knowledge."

In a later case (Forrest *v.* Glasgow and S.W. Railway, January 27th, 1910) decided by the Scottish Courts, the same principle was enunciated—namely, that the employer cannot shelter himself behind the formal disclaimer in his contract. In that case the plaintiffs had agreed to do certain work on a railway for a lump sum. In making their estimate for the cutting and excavation, the contractors

relied on a journal of borings which had been made by a servant of the railway company.

It appeared, however, that as regards a part of the excavation, the alleged journal of bores was constructed by the engineer of the defenders from information afforded by a servant of the railway company, who was not a trained or experienced borer, and that such information was defective in itself, and was not adopted by the defenders' engineer as it was received, but it was interpreted by him according to his personal impression or opinion of what his informant meant. The contract, however, contained a clause to the effect that:—"Bores have been put down at various parts of the line, the position of which are shown on the small scale plan; and a copy of the journals of these bores may be seen at the engineer's office; but the company does not in any way guarantee their accuracy, or that they will be a guide to the nature of the surrounding strata. Contractors must therefore satisfy themselves as to the nature of the strata, as the company will not hold themselves liable for any claim that may be made against them on account of any inaccuracy in the journal of the bores."

The job turned out to be far more onerous than was anticipated. A much larger proportion of hard rock had to be removed. In these circumstances the contractors claimed payment of an additional sum of £106,688. Lord Johnstone, in giving judgment, said, that it would have been impossible for the contractors to check the calculations of the railway company. They were entitled to expect that skilled and independent borers would be employed. In point of fact, however, no skilled borer had been employed, and the railway company's engineer had not even made sufficiently careful use of the information which had been furnished by the journal of bores. In the result there was 75 per cent. more hard rock than was anticipated. In these circumstances his Lordship thought that the contractors were entitled to make a claim as on a *quantum meruit*, and could, therefore, recover the excess.

This decision goes even further than Pearson's case. It may not be followed in England, for it apparently gives the go-by to an express term of the contract under consideration. To rely upon any such decision for the purpose of avoiding the liabilities imposed by a specification would not be a safe course to pursue.

A SYSTEM OF CHARGING FOR ELECTRICITY.

By J. F. D. HALE.

The loss of revenue resulting from the almost universal use of metal-filament lamps has caused central station engineers to seek new applications of the commodity they sell. If one is to judge from the number of exhibitions of cooking and heating appliances that have been held recently, it is in this field that salvation is sought.

There is already in the market much that is excellent in cooking and heating apparatus, but inelastic systems of charging for current have prevented the extensive adoption of available devices.

Some undertakings have a special flat rate, and in others current is supplied at the power rate. If the maximum demand system is used, cooking and heating consumers will pay for practically all their current at the higher rate, as the load factor is very low. Evidently this makes the cost very much too high, when it is remembered that with current at 1d. per unit, electricity is equal to gas at 2s. 6d. per 1,000 cb. ft., and coal at 18s. per ton for cooking; for heating, the equivalent prices are about 4s. and 45s. respectively; and for boiling small quantities of water, electricity at 1d. is equal to gas at 5s. 6d.

The convenience and innocuousness of electrical methods will, no doubt, overcome a slight handicap of extra cost, but universal use cannot be obtained unless the cost more nearly approaches that of competitive commodities.

The writer suggests the system of charging outlined below (which, to his knowledge, has not been suggested or used before) as likely to meet the demand for an elastic tariff that will help towards the wider use of electricity.

In private residences it will be found that the intensity of illumination varies very little in different houses, *i.e.*, the candle-power installed per square foot of floor area has a fairly uniform value, the variations in effective illumination being, of course, caused by the different reflecting qualities of interior surfaces. If, then, a fixed annual charge is made (depending upon the floor area of the premises to be lighted) and a low price for each unit consumed, several desirable ends are achieved. In the maximum demand and contract demand systems consumers are penalised for extending their use of electricity. If the fixed charge is based on floor area, the consumer knows exactly what the cost of using any additional apparatus will be, and with a low rate for current consumed, there will be a tendency to more lavish use. A lavish use, while highly desirable from the supply authority's point of view, should have some limit for lighting to keep the evening maximum demand within bounds. This limit may be 1 c.p. per sq. ft. of floor area. With metal-filament lamps this is practically 1 watt of maximum *possible* demand. If a consumer desires to exceed this, his fixed charge should be increased *pro rata*. If, in a private residence of 2,500 sq. ft. floor area, the consumption is 300 units per year, and a charge of 4s. per 100 sq. ft. of floor area per annum, plus 1d. per unit, be made, the revenue will be 5d. per unit. Should the consumer install a cooking stove, he will readily understand that, while his lighting cost is not affected, the current used for cooking will be supplied at 1d. per unit.

In adopting this system, care should be exercised to obtain reliable data on which to fix the price. If a flat rate for cooking is already in operation, the price for current used may be the same. Probably the best way to arrive at a remunerative combination is to obtain the floor area of a sufficient number of consumers' premises, and the annual lighting consumptions, and select a rate which will yield a return on units used for lighting, equal to that secured at present. The fixed charge is not intended to give an adequate return on each individual demand, although it will do so on the average aggregate demand if present rates are profitable.

The average flat-rate for cooking appears to be from 1d. to 1½d. per unit. While the low rate is better, 1½d. is not too high. If undertakings can afford to supply at these rates, the system outlined is likely to suit their needs. The low price should be sufficient to show a profit on the cooking and heating supply, while the fixed charge provides for the *extra* cost of the lighting supply and the meter rent. The floor areas should be measured with considerable accuracy, and care be taken that houses of the same size have the same rating. The treatment of recesses, landings and staircases should be on a uniform plan, otherwise different assessments will be made on similar houses and dissatisfaction result. The fixed charge should be payable yearly or quarterly in advance, and should include meter rent, but not connecting or disconnecting fee. Should the supply be discontinued, the unexpired value should be returned.

The system has the following advantages: Only one meter per consumer is required; service may be neater and less expensive; work in the office and meter department is reduced; a definite minimum return is secured from each service; consumers can extend their use of electricity without trouble and with little expense; it is easily explained and easily understood; a deposit as security is not required, and should a consumer fail to pay, the loss is minimised.

It has one disadvantage, in that all record of units used for lighting is lost. This disadvantage is more apparent than real. Many undertakings divide their lighting consumers into several classes, so that when adopting the system a new classification and a "connections" census every two or three years will overcome the difficulty.

This system finds its readiest application in private residences, but there is no reason why it should not be adopted for shops, hotels, offices and small workshops. There are many minor applications of electricity which might be used with advantage by lighting consumers generally, but it is often difficult to secure their introduction when the alternative to paying the lighting rate is to install separate wiring. A chemist, for instance, will not look at a sealing-wax melter which costs 1½d. per hour for current; but the same man

would probably buy one if it could be operated at ·3d. per hour, and without the preliminary expense of extra wiring.

There is at present a demand for kettles, water jugs, flat irons, milk heaters, &c., for use on lighting circuits, and there is no doubt that, given a favourable rate, the demand would be very much greater, as such devices consume but little current, and extra wiring would be necessary only for radiators and large cooking stoves. When a consumer has had experience of the convenience of small devices, he will be more easily persuaded to install the larger, and less likely to be deterred by the cost of a little wiring.

Only comparatively wealthy people are regarded as potential users of cooking and heating devices, but it should be remembered that the gas stove is most often found in households where the "lady" (I blush for my scanty vocabulary, but I cannot find a more expressive word) does all or most of the cooking. What is true of gas to-day may be said of electricity five years hence. Well-considered schemes of hire or hire-purchase may help towards this result. With a low load-factor, profit lies only in diversity.

With only one meter per consumer there is no reason why services should not be comparatively neat affairs. At present one sees some very bad work in this connection. And it is quite common to see a meter, switch, fuses, and a wild tangle of cables occupying about 2 ft. square on a wall. I am aware that many supply authorities require a meter box to be provided, but this is generally open to the consumer, and that, in these days of growing electrical knowledge, is not quite desirable. A box 15 in. × 15 in. × 8 in. should be quite large enough to contain a 25-ampere meter, switch (operated by outside handle) and fuses, and if provided with a window (in the cover, so that consumer can see the state of the meter index), could be sealed by the supply authority, care being taken that cables are not exposed on the mains' side of the meter.

Of late the relative importance of the lighting load has been gradually dwindling, and with the constantly widening scope for electricity supply let us hope that the day may not be far distant when station load factors of less than 20 per cent. will be considered abnormal.

PROCEEDINGS OF INSTITUTIONS.

Care of Mining Plant.

At a meeting of the Association of Mining Electrical Engineers (Newcastle Branch) on December 3rd, Mr. Clothier strongly urged that the first examination should be held without delay, as many members had joined under the impression that examinations would be held at an early date in the history of the Association. Dr. Thornton said that it had been decided to hold the first examination early in the New Year.

A discussion on Mr. R. R. Smith's paper on "Inspection and Repair of Electrical Plant Underground" was then commenced.

Mr. Burrows mentioned the great importance of providing lock washers on all electrical switchgear and machinery, especially in the case of alternating current plant. He did not consider locknuts good enough, as he had come across many cases where the nuts locked upon themselves, but not on the bolt or stud. With regard to insulation resistance, he found that when the cable was about to break down, the insulation resistance gradually got lower until the critical point was reached, at which it broke down quite suddenly. He thought that the Association should compile a small handbook, for distribution amongst the members, giving a list of the parts of a plant which should be specially watched for trouble. In oil switches, he considered, there should never be less than a 3-in. head of oil above the contacts. He mentioned one type of oil switch at present on the market, which was provided with a butterfly attachment, which, on the switch acting, put the oil in motion in such a direction that the arc was swept out. He instanced one day on which a large number of these switches operated under short-circuit some 300-400 times, but only a small proportion had to be opened out, and these required renewal of the sparking tips only. His experience had been that in switches provided with separate tanks for each phase, there was a tendency for the arc to travel outside of the tank.

Mr. Barker said that his rule for the insulation resistance for motors was 1 megohm per 1,000 volts. His practice was to lock nuts by means of a split pin passing right through the nut and the stud. He had found mice to be a prolific source of trouble in H.T. switch gear, and he mentioned several instances.

Mr. Clothier said that the objection was sometimes raised against lock washers that they injured the nuts, but it was not correct practice to use them under nuts which had to be removed frequently. In these cases "Castle" nuts should be used. Regarding the necessary head of oil in switches, he said it was a curious thing that oil under a pressure of several hundred pounds per square inch did not act as well as under a few inches head only. Breaking the rated current of an oilswitch was no test, as under short-circuit conditions a switch might have to deal with 20 times normal current. In modern switch gear designs there should not be the slightest trouble due to vermin. He did not consider it good enough merely to label a switch controlling a cable on which a man was working. It should be locked off, and the key be in the possession of the man who was doing the work. Also it was not safe merely to open the oil switch: there should be a definite air gap such as was provided by an isolating switch. The National Electrical Manufacturers' Association had approached the Home Office regarding the rule that all holes had to be bushed, and it was anticipated that this would not be insisted upon under the new rules.

Mr. Simpson said that he had often seen dead mice right across phases without any apparent harm resulting (except to the mice). He had found loose cores to be a common defect in transformers.

Dr. Thornton said that in D.C. systems surges of 50 per cent. frequently took place, but the period was so short that they merely caused a slight flicker in an incandescent lamp. He was at present experimenting in this direction, and had got some surprising results. He had recently seen some experiments on cables protected by the core-balance system, and this appeared to be so effective that it should be possible to saw through a live cable without being aware that it was alive. The first contact between the cores tripped the switch at the supply end.

The Magnetic Properties of Iron and its Alloys in Intense Fields.

By Sir Robert A. Hadfield, F.R.S., and Prof. B. Hopkinson, F.R.S., Members.

(*Abstract of paper read before the* Institution of Electrical Engineers, *London, December 8th*, 1910.)

The magnetic properties of materials in fields of very high density are of great scientific interest, because the relation between B and H which, in the moderate fields employed in practice, or in the ordinary methods of testing, is so complicated and dependent upon so many variables as to defy analysis, then assumes a very simple form. Practically the whole of the magnetic molecules then set themselves in the direction of the magnetising force, without regard to their mutual actions. The relation between B and H becomes—

$$B = H + 4\pi I;$$

where I, in the terms of the theory, is the sum of the magnetic moments of the molecular magnets contained in unit of volume.

If it can be assumed that the moment of a molecular magnet is unaffected by the magnetic forces to which it is subjected, the quantity I, in the above equation, is a constant so far as variations of H are concerned, though it might still be affected by temperature and any other physical conditions which can affect the properties of a separate molecule. The experiments of Ewing and Low and of Du Bois show that in iron, nickel and cobalt and some alloys, B does, in fact, exceed H by a nearly constant amount when H lies between about 2,000 and 25,000 C.G.S. units. These experiments, while they do not negative the possibility of some dependence of the molecular magnetic moment on the external force, give strong grounds for supposing that, at any rate, in the materials referred to, the mutual attractions between the molecules are almost completely overpowered by a force of 2,000 C.G.S. units, and that if the force is not more than 25,000 the magnetic moments of the molecules are unaltered by it. The saturation value of $4\pi I$, the constant quantity by which B exceeds H, within these limits of the latter quantity is then as definite a physical constant for the material as is the density. We propose to call this constant the "magnetism" of the material; or where any confusion can arise with other uses of the word, the "specific magnetism."

It appeared to us that an examination of a series of alloys of iron with carbon and with other metals in fields of very high intensity might lead to results from which some general deductions could be drawn, not only as to magnetic properties, but also as to the constitution of these bodies. The great advantage of the method for this purpose lies in the fact that the saturation value of $4\pi I$ in a material consisting of a mixture of substances is dependent only upon the relative proportions and on the magnetic properties of the several constituents separately, and not on their arrangement in the mass.

The material for the research was at hand in the form of a series of alloys prepared at the Hecla works. The alloys have already been the subject of extensive investigation, and many of their physical properties are known. In particular, magnetic tests by the magnetometer method have been carried out on many of them, the force used ranging up to 40 C.G.S.*. In composition the alloys cover a wide range, including iron-carbon steels, nickel steels, and manganese steels, with varying proportions of the added elements.

The general dimensions of the magnet on which most of the tests were made are shown in fig. 1. The vertical limbs are of rectangular section, 10 cm. by 20 cm. The pole-pieces are cylindrical, and are made a good fit in holes at the top of the vertical

* Barrett, Brown and Hadfield, *Proceedings* of the Institution of Electrical Engineers, Vol. 31 (1901-2), p. 674.

limbs, so that they can slide axially and be clamped in any position by means of set-screws. The yoke is wound with about 1,600 turns, and each pole-piece with about 400 turns of No. 14 S.W.G. wire.

For producing the highest fields the magnet was fitted with the pair of pole-pieces shown in place in fig. 1. With the tips of these ½ in. apart, and with a current of 30 amperes passing in the coils of the magnet, the two parts of which were placed in parallel, a field of about 22,000 C.G.S. could be obtained in the space between the flat ends of the pole-pieces. The distribution of the field was determined by means of concentric annular test coils, and was found to be constant within 1 per cent. over a circle of 2·5 mm. radius. By increasing the current to 60 amperes, which, however, could only be kept on for a short time, the intensity of the field could be increased to 25,000 C.G.S.

The material was for the most part in the form of rods about 5 mm. diameter. The magnetic test pieces were turned down from these rods into little cylinders ⅜ in. diameter. They were, in most cases, ½ in. long. The testing coil consisted of 16 turns of No. 38 wire (diameter over insulation 0·057 mm.) wound on a brass bobbin which just fitted over the test piece. A second coil also of 16 turns was wound outside the first with a layer of paper between the surfaces, to measure the magnetising force in the neighbourhood of the specimen. As it was not possible to make sufficiently accurate measurements of the dimensions of such small coils, the effective areas were determined by magnetic measurements.

The galvanometer used in most of the tests was of the moving-coil type made by Nalder Bros., and had a period of about 16 seconds.

The results obtained with the moving-coil galvanometer were checked by comparison with similar measurements on a suspended-magnet instrument (Broca type, made by Cambridge Scientific Instrument Co.) of much longer period (about 30 seconds). Measurements of I for the same piece of iron obtained with this galvanometer were systematically about 1½ per cent. lower than those given by the shorter period instrument.

In making a test, the pole-pieces were gently butted up to the ends of the test piece and fixed in position. The testing coil was first inserted with a brass dummy in place of the test piece, the current in the magnet coils was reversed, and the fling observed on the ballistic galvanometer, which was connected to the inner coil. The brass piece was then replaced by the iron test piece, the current again reversed—care being taken that it should have exactly the same strength as before—and the fling again observed. Let—

- s′ be the area of the testing coil.
- S the area of the test piece, multiplied by the number of turns in the coil—in this case, 16.
- I the intensity of magnetisation in the test piece.
- H the value of the magnetising force before the test piece is inserted.
- H′ the value of the magnetising force after the test piece is inserted.

Then the flux change corresponding to the fling obtained with the brass dummy is $H s'$, and that corresponding to the fling obtained with the test piece is $H' s' + 4\pi I S$. The difference D of the two flings will, therefore, on the same scale, represent—

$$4\pi I S - (H - H')s'.$$

Since the current and the distance between the pole-piece are exactly the same whether the dummy or the test piece be in position, the magnetising force will be the same except in so far as it is disturbed by the introduction of the test piece. The disturbance so produced is nearly proportional to $4\pi I S$. Ultimately, therefore, the difference of the two flings is proportional to $4\pi I S$ and the values of I for two different specimens are in proportion to these differences. This comparison is, to a high degree of accuracy, independent of any knowledge of the correction $H - H'$, and the comparison of I for two specimens based upon it does not involve any accurate knowledge of the area s′ of the testing coil, but only a knowledge of the area of the test-piece. The latter can be accurately measured, and it is probable that the ratio of the magnetisms of two steels can be measured by this method with an accuracy of 1 part in 200.

For determining the absolute value of I, however, it is necessary to obtain the absolute value of $H - H'$, the reduction of the magnetising force caused by the introduction of the piece.

The observed fling must be multiplied by 1·16 in order to arrive at the fling corrected for end effect.

Taking due account of the possibility of an error of 1 per cent., arising from the end correction in the high field, we feel justified in concluding that the value of I in nearly pure iron is the same, certainly within 2 per cent. and most probably within 1 per cent., when $H = 21{,}000$ as it is when $H = 8{,}000$.

This result receives additional confirmation from a study of the way in which the state of saturation is approached. This is shown in fig. 2, which refers to pure iron (S.C.I.). It will be seen that the change in I when the effect of the joints has been reduced by compression is hardly perceptible until H is less than 1,000. Similar curves were obtained from a number of other materials. With two or three exceptions, the state of saturation was reached within 1 per cent. at $H = 5{,}000$.

The sample of Swedish iron (maker's mark, S.C.I.) contained less than 0·2 per cent. of impurities.

The mean value of I for pure iron obtained with the Broca galvanometer is 1,650, and with the Nalder galvanometer 1,675.

The following are the most important results obtained from the work so far as it has progressed at present:—

1. Every alloy examined, without exception, has a definite saturation intensity of magnetisation. In most cases this is reached in a field of 5,000 units, but in a few there is a small increase, as between 5,000 and 25,000. The forms of the curves of magnetisation connecting I and H in these exceptional materials, however, leave no doubt of the existence in them also of a saturation value of I. Every one of the materials tested, without exception, behaves as though it consisted of a mixture of magnetic substances with non-magnetic substances having a permeability not differing materially from unity. This holds good also for the non-magnetic or nearly non-magnetic nickel or manganese alloys, and, in this respect, our results differ from those obtained by Ewing and Low—according to whose experiments a nearly non-magnetic manganese steel had a constant permeability of about 1·4. Among all the alloys which we have tested there is none having a constant permeability differing from unity by more than 2 per cent.

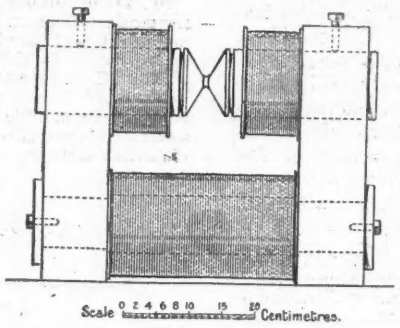


FIG. 1.

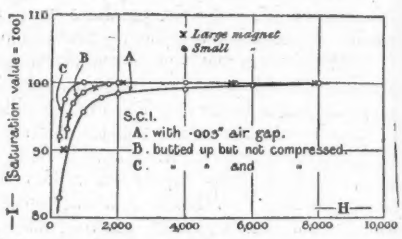


FIG. 2.

2. There is in the series no alloy having a higher specific magnetism than pure iron.

3. The saturation value of I for pure iron of density 7·80 in absolute units is 1,675 within 1 per cent. This is slightly lower than the values obtained by Ewing and Low and other experimenters.

4. In an annealed iron carbon steel in which other elements are present in small proportions the specific magnetism is less than that of pure iron by a percentage equal to six times the percentage of carbon. This result constitutes a verification, in the case of annealed iron-carbon alloys, of the linear relation connecting the magnetism of a mixture with the magnetisms of its constituents. In this case there are two constituents, mechanically mixed, viz., pure iron and iron-carbide, the percentage of iron-carbide being 15·5 times that of the carbon in the steel. It is readily deduced that the magnetism of carbide of iron is about two-thirds of that of pure iron.

5. Quenching an iron-carbon alloy from a high temperature reduces the specific magnetism by a large but somewhat uncertain amount.

6. The addition of silicon or aluminium to iron results in a reduction in specific magnetism which is roughly in proportion to the amount added as though the addition behaved as an inert diluent. If carbon be present, however, silicon seems to neutralise its action to some extent. For instance an alloy containing 2·28 Si and 0·67 C is 3·6 per cent. less magnetic than pure iron, whereas if the carbon had its full effect as in iron-carbon alloys, and the silicon were simply an inert diluent, the reduction would be 6·3 per cent.

7. The observations on the alloys of iron with nickel and with manganese, or with both these elements, have failed to reveal any simple relation between their magnetism and their composition. It is probable that this is due to the peculiar effects of heat treatment on these substances. When these effects are sufficiently known it may be possible to apply to the manganese and nickel alloys the same kind of magnetic analysis as we have applied to the carbon steels.

DISCUSSION.

PROF. SILVANUS P. THOMPSON, in opening the discussion, said the results confirmed Ewing's tentative theories. The experiments demonstrated that permeability decreased as flux density increased, and explained the position of some of the so-called non-magnetic steels. It was important to trace whether there was any relation between the stages of quenched iron and the constituents; an important point established was that a piece of iron behaved as the sum of the separate constituents.

MR. W. M. MORDEY said it was interesting to find that iron gave the highest results magnetically, but it was unfortunately an unstable material lacking permanence, and we could not look to it with any great hope for dynamo and motor work. We wanted to know more about the specific resistance of iron. A small proportion of silicon increased its specific resistance enormously without affecting its value for magnetic purposes. An iron of high permeability and exceedingly low density under forces of ½ H, was much required now.

MR. GERALD STONEY referred to Prof. Barrett's researches, in which the possible utility of silicon and aluminium alloys was pointed out. What was wanted was a non-magnetic steel which could be machined.

PROF. MORRIS said the paper helped one to establish a sound theory in magnetic research. More information regarding manganese was wanted; it might be magnetic at some stage. He mentioned that Dr. D. K. Morris had pointed out a method of testing by means of a transformer, which, while it introduced some complications, got over some of the authors' difficulties. The curves appeared to show that the hysteresis loop should come up to a fixed point.

Another speaker suggested that breakage of armature teeth, apparently strong enough mechanically, might arise from molecular alterations due to rapid flux changes during reversal.

PROF. B. HOPKINSON, who had summarised the contents of the paper, in the absence of Sir R. A. Hadfield, briefly replied to the points raised. In almost every case the specimens listed in the appendix had been tested to 25,000 C.G.S. units; every piece was tested to saturation. Permeability could easily be calculated from the data given; it did not appear that there was any steel with the constant permeability found by Ewing or the nearly constant permeability of manganese steels. Pure iron, when the induction was pushed to high values, was stable—even large disturbances did not affect it. The ballistic method was sufficiently accurate when testing with high fields, although it might be deficient with low fields. He found that a rise in temperature reduced the intensity of magnetisation from the beginning, and it diminished steadily, disappearing at 700° C.; at all temperatures the material showed saturation. Temperature undoubtedly affected the individual molecules—possibly it changed the nature of some, but not others.

The Blackening of Tungsten Lamps.

By PROF. G. W. O. HOWE, M.Sc.

(*Abstract of note presented at the meeting of the* ILLUMINATING ENGINEERING SOCIETY, *on December 9th*, 1910.)

THREE years ago a number of Osram lamps were installed in the Lecture Theatre of the Electrical Engineering Department of the Central Technical College, two in series on 200 volts; three pairs were 110-watt lamps, of which three remain unbroken after more than 1,500 hours' running; they take 100 watts and give 36 mean horizontal candle-power, corresponding to 2·8 watts per candle. Some of them blackened considerably, and the deposit was found to be of metallic copper, projected from the points where the filament was connected to the leading-in wires, clear patterns of the glass stem, &c., being projected on to the bulbs. There is reason to believe that the bombardment proceeds only from the joint with the negative leading-in wire, which is about 1 cm. from the other one. The joints are made by arcing between the filament and the leading-in wires, which contain a certain amount of copper, and it is suggested that copper should be excluded from the joints. The small lamps of the same make show no sign of a pattern.

[We have a similar 125-watt Osram lamp which has burnt in our office for at least 8,000 hours, probably nearly 9,000, on 200 volts D.C. The polarity of this lamp has never been changed. The bulb is somewhat blackened, and there is a rich copper mirror round the neck and upper portion of the bulb, but we have not been able to identify anything in the shape of a shadow-picture of the glass stem.—EDS. E.R.]

Control of Electric Winding and Hoisting Engines.

By DR. E. ROSENBERG, M.I.E.E.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS, *Manchester, December 6th*, 1910.)

AT present there are in Great Britain and the British Colonies alone such a great number of winding engines in actual service, or in process of erection, that one can safely say that for certain conditions, at any rate, electric winding has not only proved economically possible, but a distinct economic success. Especially in cases where power can be bought cheaply from a public power station, or where the private power station can be used to supply either several winding engines, or at the same time a great variety of motors with a fairly good load factor, the advantages of cheap power production by the adoption of large and economical working units have more than balanced the necessity of double conversion of energy. In many cases the electric winder is not only the cheapest in working, but also the cheapest in the first cost, and when this most important economic advantage is established, the user also appreciates the additional amenities provided by the excellent technical features of electrical drive, namely, the ease and safety of control, the entire absence of jerks, and the perfect regularity of drive from full to creeping speed.

As far as the control of D.C. and polyphase induction motors is concerned, we have mainly to distinguish between rheostatic control used for either type of motor, and Ward-Leonard control used only for D.C. motors, for which a special controlling generator is employed. The rheostatic control, that is, the starting from a substantially constant bus-bar voltage by the insertion of a gradually decreasing resistance, inserted either in the armature circuit of a D.C. motor, or in the rotor circuit of an induction motor, can be done either with metallic or liquid resistances. For large motors, and nearly always for induction motors, liquid controllers are employed.

The Ward-Leonard control requires a special direct-current generator with separate excitation, which can be changed between the limits of zero and a positive and negative maximum. The winding motor is externally constant excited, and its armature connected to the generator armature without any switches or controller. The speed of the winding motor is, therefore, in approximate proportion to the voltage of the controlling generator, and the direction of rotation is directly dependent upon the direction of the exciting current of the generator. A small shunt controller gives perfect control over the whole machine.

The Ward-Leonard system gives wonderful ease of control, and very light and simple controlling apparatus; the amount of machinery, however, is increased, as are the initial costs, and the great advantage of practically negligible starting losses is partly counterbalanced by the loss of efficiency in the motor-generator. As far as current consumption is concerned, the Ward-Leonard system will show to great advantage if the starting and braking periods are of comparatively long duration, and the winding intervals short, also if trips with reduced speed (for instance, for men winding) are of frequent occurrence; whereas the straight rheostatic control will show up best if full-speed runs and winding intervals represent a very great portion of the whole working time.

Very often it is considered essential to guard against interruptions of the supply, and to provide means which would enable the continuation of at least one trip. The Ward-Leonard system lends itself very nicely to a storage of energy by coupling with the motor-generator a fly-wheel (Ilgner system). This also allows of equalising the demand on the power station by providing the motor of the Ilgner set with a considerable drop in speed between no load and overload, and thus giving the fly-wheel an opportunity to return a part of the stored energy when the load grows, and to store energy between the periods of work. Instead of the fly-wheel, a third machine—viz., a D.C. generator, can be used, which works in parallel with a storage battery.

In the case of D.C. winding motors working direct from the bus-bars, it is possible to use a D.C. motor coupled to a fly-wheel and fitted with special field windings, or an automatic shunt rheostat, which, according to the momentary requirements, will cause the machine to work either as a motor or as a generator, and so either to store energy in the fly-wheel or to convert the stored energy into electrical energy. An accumulator battery, either work or without an automatic booster, will serve the same purpose.

In case of A.C. winding motors similar ends have been achieved by running from the mains a synchronous motor coupled to a fly-wheel, which motor, in case of failure of the line current, will act as a generator and feed the winding motor; or by running a rotary converter, the D.C. part of which is connected to a D.C. fly-wheel motor. In the latter case the equalising action of the fly-wheel during the ordinary service is also made use of.

The aim of the present paper is mainly to study the electrical conditions of control, and more particularly the conditions for braking in the different systems. We have always to reduce the speed at the end of a trip and to bring the winding engine to a standstill, but very often we have also to lower unbalanced loads instead of lifting them, and in this case the winding motor, if it is to be used at all, has to work as a genenerator converting mechanical energy into electrical energy. In many cases the change from positive to negative motor torque will occur during each trip.

If no tail rope is used, and the load on the up-going cage is just balanced by the load on the down-going cage, then the rope weight will, in the first half-trip, exercise a positive, and in the second half trip, a negative torque, and the winding machine has at first to act as a motor and then as a brake.

As long as the speed of the Ward-Leonard motor-generator is kept constant, the shunt regulator of the controlling D.C. generator determines fully the E.M.F. of the controlling machine, and if the winding motor is mechanically driven from outside, the speed of the constantly excited winding motor will attain a value which gives an E.M.F. in the winding motor only slightly higher than that of the controlling machine, because a slight difference will give rise to a circulating current of sufficient magnitude to balance the torque impressed from outside.

We shall assume at first that the exciting voltage is kept constant, and that there is no fly-wheel and no artificial slip in the motor-generator, also that the primary frequency and voltage remain constant. The slip of the induction motor driving the controlling dynamo will be proportional to the load, and at full load will be at least 2 per cent. The controlling machine might for constant speed have a drop in voltage from no load to full load of 5 per cent. of the maximum voltage, and the winding motor will have a similar drop in speed, say again 5 per cent., for constant voltage on the terminals from no load to full load. That would mean that the difference of the motor speed between no-load torque and full-load torque, due to all causes combined, will be approximately 12 per cent. if the induction motor has only 2 per cent. slip. If the winding motor has to exercise a negative torque of half the value of the normal working torque, the difference in speed will grow to 18 per cent.

The difference of 18 per cent. of the full speed, however, remains nearly constant in its absolute value, and therefore grows in proportion if the controller lever is put into a position for a low speed. For half excitation the lifting speed for normal load will be about 39 per cent. of the full (no-load) speed and the lowering speed for a load which would require half braking torque will be about 56 per cent. of the full speed.

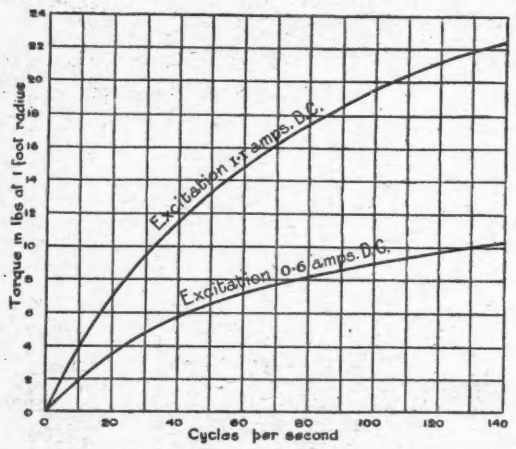
If an Ilgner set with increased slip is used, or if the exciter is coupled to the shaft of the motor-generator and its voltage is not

automatically kept constant, the differences will be even greater. It is, therefore, necessary in case of Ward-Leonard control to use a speed indicator, and not to depend upon a positive relation between the position of the control lever and the speed of the winding engine. In general, it can be said that the method of braking with the Ward-Leonard arrangement is nearly perfect, in so far as the movements of the controller lever in order to come to rest are pretty nearly the same whether the motor is driving or driven, and that a very great braking torque can be obtained from the motor. Normal current in the motor armature when used as a brake represents more than normal torque on the winding drum. If the controller is not handled too quickly there will be no unusual stresses either in the electrical or in the mechanical parts, which, of course, in any case have to be built to cope with the always recurring reversal of power.

If, however, the line voltage fails, the state of affairs alters considerably. If a fly-wheel of sufficient capacity is connected to the motor-generator, the energy supplied by the lowering load will speed up the fly-wheel to a permissible value. If no fly-wheel is applied, then the motor-generator would soon speed up to a dangerous limit, and it would be necessary in such a case to apply the mechanical brakes practically at the instant that the circuit-breaker comes out.

In a system which, instead of the fly-wheel, uses a third electric machine connected to an accumulator battery, the storage of energy could, of course, go on, as a battery, even if fully charged, is always capable of receiving energy by being overcharged.

We will now investigate the case of using the motor as a brake if rheostatic control is employed, the motor being supplied with current from general bus-bars. The first case would be that of a direct-current shunt motor fed from direct-current bus-bars. This case mainly applies to comparatively small motors, up to a



Performance of Eddy-Current Brake.

few hundred horse-power. The direct-current motor can be built for combined series and shunt regulation, viz., variable resistances inserted in the armature circuit and a shunt regulator in the exciting circuit. For all speeds within the range of shunt regulation braking is done most effectively without any additional apparatus, because the motor will work as a generator and return power to the line.

For a given position of the shunt regulator (with the series resistances cut out) the motor, when working as a generator and exercising half full-load brake torque, will develop (under the above assumptions) a speed approximately 7 per cent. higher than the speed which it would develop for the same controller position if it was exercising full torque as a motor. It is assumed that the bus-bar voltage remains constant.

For other positions of the controller, when resistance is inserted in the armature circuit, the conditions are entirely different; the E.M.F. impressed upon the motor armature is no longer approximately constant, but will vary with the load. Working as a motor, the E.M.F. of the machine will be considerably smaller than the bus-bar voltage, and working as a generator the machine will have to develop considerably greater E.M.F. in order to return power through the resistance to the line. A position of the controller which allows for the motor, before starting, less than normal current, would allow a very dangerous speed for the same machine when generating. Such controller positions are in general not suitable for lowering loads, and this regenerative control will mainly be used with the controller in "full-on" position. It will often be the case that to star tthe lowering trip, motoring current has to be sent at first into the motor. But it is essential that the controller lever should soon be pushed to the "full-on" position, and kept there in order that the speed may not grow beyond control.

The regenerative control cannot be used to slow down the motor at the end of the trip. For this, either the controller has to be moved quickly into the "off" position and the mechanical brake applied, or the controller may be quickly moved beyond the "off" position and the first steps for the reversed movement used, which allow outside current to enter into the motor in such a direction as would be needed for lifting the load which is being lowered.

In case the speed throughout the whole lowering trip has to be kept lower than the speed which the motor develops with all the armature resistance cut out, for instance, for lowering men, counter-current must be used during the whole trip.

A metallic controller which is to be used for braking with counter-current will have to be made of more than double the resistance of an ordinary controller, and a separate portion of the controller must be used for braking.

Regular braking with counter-current is a very safe, but naturally wasteful method, as not only is no energy returned to the line, but a current from the line is consumed equal to the brake current. Whether this waste of energy is objectionable or not, depends upon the frequency and duration of down trips with unbalanced load.

With a polyphase induction motor used as a winding motor, the conditions are exactly analogous to those of a direct-current shunt motor (without shunt regulator) fed from bus-bars. If the rotor is short-circuited, the machine will, for a slight increase in speed, act as an induction generator, and return power to the line.

In order to brake the moter down to lower speeds, counter-current is required, and exactly the same relation for the controller resistance holds good as for the shunt motor. Driving the motor at over-synchronous speeds with resistance inserted (controller in lowering position) would here also cause too high a speed to be be reached.

We can disconnect the armature of a direct-current motor from the line, and connect it either to a part of the resistance of the starting controller or to another resistance. If the machine is constantly excited from the bus-bars, the braking torque or braking current will be in direct proportion to the speed of the motor, and in inverse proportion to the controller resistance; therefore, in order to keep perfect electrical control of a constant lowering load from the start up to the very end of the trip, it would be necessary at first to increase, then to reduce the outside resistance gradually in proportion to the desired momentary speed. Of course, a constant resistance could be used which would only limit the steady speed of the lowering load, and some other means could be used to bring the load to rest at the end of the trip. For instance, a resistance which in series with the armature would allow full-load starting current to be taken from the line, will, when connected across the armature, allow a braking current equal to half full-load current for approximately half-speed of the machine driven by the load. To allow full lowering speed for a brake torque equal to half full-load torque, a controller resistance of the double value would be required, provided that no regulation in the shunt field of the motor is intended.

For a given speed the braking torque is nearly in inverse proportion to the controller resistance.

An induction motor, a part of which is excited by direct current (either the rotor or stator) and the other part connected to a resistance, is distinguished from ordinary alternating-current generators mainly by the fact that the air-gap is exceedingly small, and that, therefore, the armature reaction is exceeding high.

This big armature reaction has a very important bearing on the behaviour of the machine, because it is only for comparatively small armature reaction that it can be said that at constant speed the torque will be in nearly inverse proportion to the outside resistance. As soon as the armature current exceeds a certain limit, a reduction of the outside resistance will not only not increase, but even reduce the braking torque, because a slight increase in armature current is accompanied by a more than proportionate reduction in field strength. With short-circuited slip-rings, the torque obtainable at higher speeds is very small.

In a star-wound machine, with terminal No. 1 connected to the negative direct-current supply, terminals Nos. 2 and 3 in parallel connected to the positive supply, the direct current replacing the three-phase excitation will have to be of the value 1·414 the alternating current.

If we connect only two of the terminals to the direct-current supply, the equivalent direct current will be 23 per cent. higher than the measured value of the alternating current. Exactly the same holds good for delta connection.

We could excite the stator with a current as above, corresponding to the full-load stator current, and could insert in the rotor a resistance which would just allow normal rotor current to flow. In this case the magnetic conditions would be exactly the same as in an induction motor working with full-load current at any moment of the starting period, and we should have normal torque at the circumference of the rotor.

This is not necessarily the greatest torque we can obtain for this excitation.

For a motor with 0·9 power factor, the maximum obtainable torque as a brake could be increased by nearly 25 per cent. if the field had such a low saturation that it was capable of 60 per cent. increase in value with corresponding increase in field ampere-turns. We can get the same maximum torque at any speed so long as we change the resistance in the rotor circuit in strict proportion to the speed.

The relation between torque and D.C. excitation is a simple one, as the torque always increases with increased excitation, whatever the momentary frequency may be, whereas the relation between torque and resistance is a very complex one. For a decrease of resistance the torque might be increased or decreased, dependent upon the momentary speed. Therefore, it would not be very safe to use the variable resistance of the starting controller for braking purposes, as the driver might easily overshoot the mark in trying to make the brake more effective, and then he would not be able to stop the load. It would, however, be possible to change the resistance automatically in proportion to the frequency of the rotor currents.

For a constant excitation and a constant resistance in the

armature there always exists a critical speed up to which the torque increases and beyond which the torque goes down with increased speed. If we make the exciting current and the resistance high enough, we can easily ensure that the brake torque wanted is well below the obtainable maximum torque, and that the speed wanted is well below the critical speed. The load can be lowered with safety with the certainty that the speed will not be exceeded. For stopping, mechanical brakes would be applied.

This kind of brake requires a supply of direct current, which will necessitate in many cases the use of a small special motor-generator. If it is required, in case of the supply failing, to lower the load without being dependent on the mechanical brakes alone, it will also be necessary either to use a fly-wheel for the motor-generator or a small accumulator.

Using the motor itself as a brake with direct-current excitation, renders it impossible to use, at the same time, the combined effort of the brake and the motor, say, working with a counter-current, and it requires some special switching arrangement for stator as well as rotor. The stator winding must be connected to a controller which allows three different connections: (1) Alternating bus-bars, forward movement; (2) alternating bus-bars, backward movement; (3) direct-current bus-bars for braking. Also for the rotor, if ordinarily a liquid starter is used for motoring, a switching arrangement will be necessary to throw a metallic braking resistance on to the slip-rings.

It is sometimes desirable to provide a special electric brake independent of the motor. The use of the eddy-current brake for very large winding engines, which are required under certain circumstances to lower unbalanced loads consisting of men for several hours at a reduced speed, which should never be exceeded for safety purposes, was first (as far as my knowledge goes) recommended by Mr. G. K. Chambers in Johannesburg, and very large apparatus of this description is now under construction.

From the test curves published for eddy-current brakes with copper disks, and from experiments made by myself on eddy-current brakes with cast-iron armatures, I believe that an essential difference exists between the two. In the brakes as described by Morris and Lister, at first for constant excitation, the torque increases with the speed, but falls after a critical speed is reached. An eddy-current brake like this, used for winding engines, would have very serious disadvantages.

In 1902 I stated that with eddy-current brakes with cast-iron armatures I was never able to find a reduction in torque with increase in speed, but, on the contrary, a steady increase. The power absorbed by the brake increases at first nearly in proportion to the square of the speed, and even with high frequencies it is still more than proportional to the speed (see figure); in apparatus built more recently, I have always found this experience confirmed, and since for practical use this quality is of the greatest importance, the eddy-current brakes to be used in connection with winding engines were made with cast-iron armatures. The cast-iron armature has, besides great simplicity, rigidity and cheapness, the advantage that the specific resistance of the material is approximately 40 times greater than that of warm copper.

The power absorbed is made up of three components: friction and windage, which are practically negligible; the C^2R losses of the eddy currents, and the hysteresis losses of the cast-iron armature. In an ordinary short-circuited armature the hysteresis losses would be reduced with increased speed, for although the periodicity is increased, the resultant field falls more than in inverse proportion. In an ordinary short-circuited armature with defined path for the current, the C^2R losses also do not rise appreciably after a certain speed is reached. Here, however, I believe that for low speeds the flux penetrates the whole depth of the cast-iron armature, and that with increased speed, and therefore increased voltage per inch axial length, the current density near the surface increases, and that this surface current opposed to the primary flux shields the deeper parts of the armature, so that fewer and fewer lines of force penetrate and the currents crowd more and more on the skin of the armature. Therefore, with increasing periodicity, the resistance of the eddy-current path increases, and this also has the effect that the resultant flux does not tend to fall off, since in order to maintain the current with the increased resistance, a higher E.M.F. is required. Of course, owing to the crowding of the magnetic lines on the surface, the hysteresis will be increased if the total flux is not reduced with increased speed. But in general, I do not believe that the hysteresis losses are the most important even at high frequencies. The volume of current in the armature remaining practically constant above a certain speed, there is no other explanation for the increased power consumption than the increase in apparent resistance, or for the increased torque, than an increase of working flux, and not a decrease as usual.

The eddy-current brakes used in connection with large hoisting engines are able to deal with continuous service—that is to say, with continuous trips of unbalanced loads of men or material from the surface to the bottom of the pit, and it is possible to regulate the speed without use of the mechanical brake down to a very low value. The field is excited from direct-current bus-bars, which are fed by a motor-generator, and on which a storage battery is floating; therefore, the brake is also available in case of failure of the main supply current, and in such cases the excitation is switched in automatically.

The eddy-current brake in another form can be used to make the Ward-Leonard braking method also available if the Ward-Leonard motor-generator or the engine driving such generator has a comparatively small fly-wheel, which for lowering the load during a long trip would speed up dangerously. In such cases it will be sufficient to fit a stationary pole of small dimensions opposite the fly-wheel rim, and so induce eddy currents in the fly-wheel, which consume the power supplied to the fly-wheel set.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

SOUTH AFRICA.—Invoices must be produced in support of the declared value, weight, tare, gauge or measure of all goods entered at the Customs for importation into South Africa. Where there are separate invoices of different kinds of goods, they should be under cover of a "statement" detailing the net value of each invoice and all costs and charges in connection with shipment. Declarations of value must state the current value of the goods for home consumption at the place of purchase, including the cost of packing and packages, but not including agent's commission if it does not exceed 5 per cent.; no special form of invoice has been prescribed. In order that British goods may benefit by the preferential treatment accorded to them under the tariff of the South African Customs Union (which includes Cape Colony, Natal, Transvaal, Orange Free State, Southern Rhodesia, Bechuanaland Protectorate, Basutoland and Swaziland), they should be accompanied by a certificate of origin in the form given below. This certificate must be written, printed or stamped on the invoice of the goods or attached thereto; if not attached, full particulars of the goods concerned must be shown in the certificate. In the case of postal packages not exceeding £10 in value, the full form of certificate is dispensed with, providing the contents are not merchandise for sale, but a shorter statement, as shown below, must be endorsed thereon.

A.—Form of Certificate prescribed to obtain a Rebate of Customs Duties on Goods and Articles, the Growth, Produce or Manufacture of the United Kingdom, or reciprocating British Colonies, Protectorates or Possessions.

I, ..., the { manufacturer / supplier } of the articles included in this invoice, have the means of knowing and do hereby certify that the said invoice being from myself ....., and amounting to ....., is true and correct; that all the articles included in the said invoice are *bonâ fide* the growth, produce or manufacture of ....., and that a substantial portion of the labour of that country has entered into the production of every manufactured article included in the said invoice, to the extent in each article of not less than one-fourth of the value of every such article in its present condition, ready for export to .....

(Signed)

Dated ....., this ..... day of ....., 19 .

Note.—When this certificate is signed by some person on behalf of a manufacturer or supplier, such person must state that he is duly authorised to do so.

B.—Certificate to be endorsed on Postal Packages not exceeding £10 in value, the contents of which are not Merchandise for Sale.

Every article herein, to the extent of at least one-fourth of its present value, is *bona fide* the produce or manufacture of .....

Signature of sender .....

In the presence of .....

Postal Officer.

Dated at .....

Note.—Persons forwarding goods, the *bona fide* manufacture of the United Kingdom, by post, should clearly state so on the form or label attached to the parcel, otherwise the contrary will be assumed.

(To be continued.)

The Frankfort-Lahmeyer Works.—The question of the absorption of the Frankfort Dynamo Works by the A.E.G. was raised at the last meeting of the Frankfort Municipal Council, when the Mayor was asked to make a final endeavour to retain at least a large portion of the undertaking in the town, inasmuch as it had provided employment for 4,000 workers and 1,200 officials with their families, and the removal would greatly prejudice the interests of the city. The speaker, who represented the situation in a very pessimistic light, was apparently under the impression that the whole of the work of manufacturing is to be transferred to Berlin, but he was corrected by a second member who declared that only a portion of the manufacturing was to be removed, the construction of heavy machines remaining in the town. In reply to the discussion the Mayor remarked that the city could do nothing in the matter. The city had successfully intervened in a number of former cases of proposed migration, but it had been possible to offer something to induce the firms concerned to remain. What could the Town Council offer to the A.E.G.? They could not write and say they would be greatly embarrassed if the works were removed. It would be somewhat different if State authorities, as, for instance, the military authorities, were in question, but it would not correspond with the dignity of the town to present a petition to a private company. The removal, the Mayor concluded, was much to be regretted, but the development could not be stopped, and the town would have to endeavour to attract new industries to an increasing extent in order to compensate for the threatened loss.

NEW PATENTS APPLIED FOR, 1910.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

27,635. "Improvement in rails for electric traction." T. F. THOMSON. November 28th.

27,641. "Improvements in and relating to miners' electric lamps." O. OLDHAM. November 28th.

27,647. "Improvements in the electro-deposition of zinc." S. O. COWPER-COLES. November 28th.

27,652. "Improvements in street or station indicators for electric trains, tramcars, and the like." H. ALWIES. (Date applied for under Sec. 91 of the Act, November 26th, 1909, being date of application in United States.) November 28th. (Complete.)

27,696. "Improvements in electric conversion." S. CABOT. (Date applied for under Sec. 91 of the Act, December 4th, 1909, being date of application in United States.) November 28th. (Complete.)

27,701. "Improvements in electrically-driven drilling apparatus." P. M. JUSTICE. (La Société Anonyme Electricite et Electromecanique, Belgium.) November 28th. (Complete.)

27,710. "Improvements in filament supports for electric glow lamps." LICHTWERKE G.M.B.H. (Date applied for under Sec. 91 of the Act, November 27th, 1909, being date of application in Germany.) November 28th. (Complete.)

27,712. "Improvements in fusible cut-outs." C. M. DORMAN, R. A. SMITH and H. G. BAGGS. November 29th. (Complete.)

27,719. "Improvements in and relating to electric vibrators and massage appliances." H. A. LEVENS. November 29th.

27,725. "Improvements in motor-supports for electric tramcar trucks." BRUSH ELECTRICAL ENGINEERING CO., LTD., and S. LEECH. November 29th.

27,755. "Improvements relating to the manufacture of filaments for electric incandescent lamps." H. W. EDMUNDSON and W. POTTS. November 29th.

27,797. "Improvements in and relating to electrically-lighted lamps for motor-cycles and other motor vehicles." G. E. PARTRIDGE. November 29th.

27,798. "Electric railless trackway with above-ground current conductors." H. SEFTON-JONES. (Oesterreichische Daimler-Motoren Ges. A.G., Austria.) (Application for patent of Addition to No. 25,012/10.) November 29th. (Complete.)

27,814. "Method of synchronising electric or other motors for use on cranes, hoists, gun turrets, or other machinery." SIR W. G. ARMSTRONG, WHITWORTH AND CO., LTD., and F. HARLOW. November 30th.

27,825. "Improved electric switch with quick-make and quick-break action." J. MCFARLANE. November 30th.

27,857. "Conversations counter for telephones without crank handles." K. BORN. November 30th. (Complete.)

27,860. "Improvements in telephone exchanges with automatic call distributors." SIEMENS & HALSKE AKT.-GES. (Date applied for under Sec. 91 of the Act, December 9th, 1909, being date of application in Germany.) November 30th. (Complete.)

27,903. "Improvements in electrical switches of the two-way tumbler type." J. H. TUCKER. December 1st.

27,904. "Improvements in printing by means of electrotyped plates." I. T. NELSON and J. MURRAY. December 1st.

27,921. "Improvements in electric gas, or other lamp fittings." C. WATSON and J. FORD. December 1st.

27,942. "Improvements in electric arc lamps." GES. FUR MASCHINEN-UND-METALL-INDUSTRIE m.b.H. (Date applied for under Sec. 91 of the Act, December 1st, 1909, being date of application in Germany.) December 1st. (Complete.)

27,954. "Improvements in electric heaters." H. J. READ. December 1st.

27,981. "Improvements in and relating to electric signs." P. G. WATMOUGH, JUN. December 1st.

27,985. "Improvements in portable telephones and electric batteries therefor." W. K. L. DICKSON. December 1st.

27,986. "Electric apparatus for gas lighting and extinguishing purposes." T. F. CANNING. December 1st.

27,987. "Improved microphonic instrument." H. FAIRBROTHER. December 1st.

27,989. "Improvements in or relating to electric arc lamps." A. BLONDEL. (Date applied for under Sec. 91 of the Act, April 21st, 1910, being date of application in Belgium. Application for Patent of Addition to No. 4,677, 1906.) December 1st. (Complete.)

27,991. "Improvements in or connected with sparking plugs for internal-combustion engines." A. GINESTES. (Date applied for under Sec. 91 of the Act, December 2nd, 1909, being date of application in Germany.) December 1st. (Complete.)

27,993. "Improvements in and relating to dynamo-electric machines." ALLGEMEINE ELEKTRICITATS GES. (Date applied for under Sec. 91 of the Act, December 1st, 1909, being date of application in Germany.) December 1st. (Complete.)

28,010. "Improvements in and relating to electric lamps and the like." H. L. GUY. December 1st.

28,057. "Improvements in and relating to electric switches for automatic telephone systems." AMERICAN AUTOMATIC TELEPHONE Co. and C. L. GOODRUM. (Date applied for under Rule 13, December 22nd, 1909. An invention comprised in application No. 29,963, dated December 22nd, 1909.) December 2nd. (Complete.)

28,069. "New or improved electrically-insulating compound." O. V. THOMAS. December 2nd.

28,079. "Portable electric lamp." ELECTRIC EXPORT WERKE G.m.b.H., and E. GOTTSCHALK. (Date applied for under Rule 13, December 20th, 1909. An invention comprised in Application No. 29,789, dated December 20th, 1909.) December 2nd. (Complete.)

28,081. "Methods for regulating the frequency of electric currents produced by rotary field-generators." SIEMENS BROS. DYNAMO WORKS, LTD. (Siemens-Schuckert werke G.m.b.H. Germany.) December 2nd. (Complete.)

28,088. "Improvements in switching device for automatic telephone systems." WESTERN ELECTRIC CO., LTD. (Western Electric Co., United States.) December 2nd. (Complete.)

28,110. "Improved means of increasing the E.M.F. of rotary converters for battery charging and the like." A. M. TAYLOR. December 3rd.

28,126. "Improvements in or relating to electric furnaces." M. RUTHENBURG. December 3rd.

28,129. "Improvements in or relating to electric ovens." G. J. OGDEN, M. M. HAY and J. TEMPLETON. December 3rd.

28,161. "Improved centrifugally-operated contrivance for automatically intercepting or regulating the flow of an electric current from a dynamo." A. N. HAZLEHURST and LONGSTRETH'S, LTD. December 3rd.

28,179. "Improvements in and relating to condensers for electric systems." G. GILES. (Date applied for under Sec. 91 of the Act, March 10th, 1909, being date of application in Germany.) December 3rd. (Complete.)

Borough Polytechnic Institute.—The distribution of prizes and certificates at this Institute by the Earl of Lytton, will take place on Monday next, December 19th, at 8 p.m.

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of MESSRS. W. P. THOMPSON & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1909.

LIQUID CONTROLLERS AND STARTERS FOR ELECTRIC MOTORS. J. A. Liddle. 21,595. September 22nd. (Post-dated March 21st, 1910.)

ELECTROMAGNETIC APPARATUS FOR PRESERVING AND OTHER PURPOSES. A. J. Boult. (Electric Meat-Curing Co.) 23,040. October 13th.

MAKE-AND-BREAK SWITCHES. 23,224. J. Wilson. October 11th. (Post-dated April 11th, 1910.)

APPARATUS FOR OPERATING SHIPS' RUDDERS BY ELECTRICITY. E. C. R. Marks. (Soc. Anon. Italiana Gio. Ansaldo, Armstrong & Co.) 25,365. November 3rd.

ELECTRIC DRIVING. E. R. Elliston and H. Marryat. 25,586. November 6th.

METHOD OF AND MEANS FOR OPERATING ELECTRICAL SWITCHES OR OTHER DEVICES, ON THREE-WIRE SYSTEMS. F. Fernie. 25,668. November 6th.

MEMORANDUM APPLIANCES FOR USE WITH TELEPHONES AND THE LIKE. H. O. Quinn. 25,757. November 8th.

ALTERNATING-CURRENT DYNAMO MACHINES. C. A. Parsons and A. H. Law. 25,785. November 8th.

FEEDING AND REVERSING GEAR FOR ELECTRICALLY OPERATED ROCK DRILLS. B. Rohde. 26,051. November 10th.

SUPPORT OF ELECTRICAL CONDUCTORS OR CABLES. T. G. Noble. 26,059. November 11th.

ELECTRIC LIGHT SYSTEMS FOR TRAINS AND OTHER MOVING VEHICLES AND APPARATUS THEREOF. T. Ferguson. 26,289. November 13th.

ELECTRICAL SWITCHES. R. Cox. 26,422. November 15th.

COMMUTATOR BARS IN CONNECTION WITH THE ARMATURES USED IN DYNAMOS AND MOTORS. M. Heys. 26,948. November 18th.

AUTOMATIC REGULATORS FOR DYNAMO-ELECTRIC MACHINES. British Thomson-Houston Co. and A. P. Young. 27,827. November 29th.

1910.

TELEPHONE DIAPHRAGM. M. Baehr. 21,328. September 19th. (Date applied for under International Convention, March 23rd, 1910.)

CONTROL OF ELECTRIC MOTORS. F. E. Case. 22,708. September 30th. (Date applied for under International Convention, September 30th, 1909.)

METHOD OF AND MEANS FOR CONTROLLING THE POINTS OF ELECTRIC TRAMWAYS AND RAILWAYS. B. Henrard and L. Leveque. 2,810. February 4th.

CONTRIVANCE FOR FACILITATING THE RECORDING OF TELEPHONE CALLS. F. Chisholm-Ellams. 3,756. February 15th.

ELECTRIC SWITCHES. M. J. Railing and C. J. Garrard. 5,085. March 1st.

AUTOMATIC TELEPHONE EXCHANGES. Siemens Bros. & Co. (Siemens & Halske Akt.-Ges.) 7,093. March 31st.

ELECTRIC IGNITER FOR EXPLOSION MOTORS. L. Podszus. 7,617. March 29th.

EARTHING DEVICE FOR ELECTRIC SWITCHES. J. J. Rawlings. 8,858. April 12th.

ELECTRIC LAMP SHADE ATTACHMENTS. H. A. Beard and J. W. Townsend. 9,547. April 20th.

CIRCUITS FOR REGISTERS IN AUTOMATIC TELEPHONE EXCHANGES. Siemens Bros. & Co. (Siemens & Halske Akt.-Ges.) 9,634. April 20th.

ALTERNATING-CURRENT CONDUCTORS. H. W. Malcolm and R. Appleyard. 9,647. April 20th.

AUTOMATIC SAFETY CATCHES FOR LOADS OF ALL KINDS, PARTICULARLY FOR ARC LAMPS. F. Koller. 9,888. April 22nd.

ELECTRIC SWITCHES. Adams Manufacturing Co. (Cutler-Hammer Manufacturing Co.) 9,890. April 22nd.

ELECTRIC FURNACES. J. Thomson. 11,716. May 11th. (Date applied for under International Convention, May 28th, 1909.)

RECEPTACLE OR SOCKET FOR ELECTRIC LAMPS. W. S. Ryan and L. Hengerer. 13,165. May 31st.

DYNAMO-ELECTRICAL MACHINES. E. C. Ketchum. 13,380. June 1st.

SPARKING PLUGS FOR INTERNAL-COMBUSTION ENGINES. Firm Robert Bosch. 13,901. June 8th. (Date applied for under International Convention, August 3rd, 1909.)

CENTRAL ENERGY ELECTRICAL SIGNALLING SYSTEM. L. Goldstein. 16,331. July 8th.

ELECTRIC FUSES. Siemens Schuckertwerke Ges. 17,047. July 22nd. (Date applied for under International Convention, July 23rd, 1901. Application for Patent of Addition to No. 14,622 of 1909.)

ELECTRO-MECHANICALLY OPERATED SWITCH. Adams Manufacturing Co. (Cutler-Hammer Manufacturing Co.) 18,442. August 4th.

APPARATUS FOR ELECTRICALLY DETECTING RAILWAY POINTS. Siemens Bros. and Co. and L. de M. G. Ferreira. 19,970. August 26th.

INTERRUPTER PARTICULARLY APPLICABLE FOR USE WITH INDUCTION COILS. R. S. Wright. (Veifa-Werke Vereinigte Electrotechnische Institute Frankfurt Aschaffenburg.) 20,872. September 7th.

"Stannos" Wires.—Amongst installations recently carried out with "Stannos" wire are the following:—Messrs. Baxter & Impey, Birmingham, have carried out the installation of a large country house at Knowle, Warwickshire. Messrs. J. H. Harpin & Co., Birmingham, have put in a complete installation of four Siemens motors with "Stannos" wiring, for Richard Cooper & Sons, Atlas Works, Wolverhampton; and have also put in "Stannos" in country houses at Cobham, Surrey, and Burton Point, Cheshire. Messrs. E. D. Wishart, Southampton, are carrying out for Siemens Brothers the installation of a new theatre at Eastleigh, consisting of a 16-H.P. gas engine, "Stannos" wiring and "Zed" fuses. This firm are also carrying out the wiring of Summers & Payne's yacht-building yard, to the order of Siemens Brothers.

Fire: an Appeal.—Consequent upon the fire at the premises of ROSS COURTNEY & Co., Ashbrook Works, Upper Holloway, a large number of workpeople have been thrown out of employment. A committee has been formed on their behalf, and anyone feeling able to show practical sympathy with men suddenly thrown on ill-fortune at this season of the year, is invited to send subscriptions to Mr. E. R. Spackman, secretary to the committee, at the works.